A Story Outline of Evolution

By

CHAS. W. GRIMES

SHOUT
SHARE
IT

MARINE BIOLOGICAL LABORATORY.

Received August, 1937

Accession No. 47874

Given by C. P. Hoagland Co.

Place, Somerville, New Jersey

***No book or pamphlet is to be removed from the Laboratory without the permission of the Trustees.

MBL/WHOI
0 0301 0011314 8

A Story Outline of Evolution

A Story Outline of Evolution

By

CHAS. W. GRIMES

PRESS OF
THE C. P. HOAGLAND COMPANY
SOMERVILLE, NEW JERSEY
1937

COPYRIGHT, 1937

by

THE C. P. HOAGLAND COMPANY

PRINTED IN THE UNITED STATES OF AMERICA

MARINE BIOLOGICAL LABORATORY
WOODS HOLE
LIBRARY

PREFACE

IN this enlightened age, the word Evolution arouses unfortunate prejudices in certain sections. State legislatures have enacted laws forbidding the teaching of its principles in the public schools. An attempt has been made to enlighten the general public on the beauty and harmony of these principles and their relation to all things.

The primary object of this book is to present to the reader in simple language and in the fewest words a comprehensive story of the development of life. Within the memory of those still living, Science has added to the storehouse of knowledge more harmonious facts relating to natural law than had been accumulated by all the preceding generations of men. And yet, great numbers of typical individuals who have, perhaps, been denied the opportunity to pursue their systematic education very far, are deeply ignorant of many of these facts. In many cases, the story of scientific discoveries is so circumscribed by technical terms that the simple truth becomes clouded and not easily understood.

Evolution embraces all of Science and all of Art. These are divided into many branches. A lifetime may be spent

in the study of a single division. Evolution shows how these branches are tied together in one harmonious plan. It is not given to any one mind to possess a perfect knowledge of all of these branches and their relation to one another but, nevertheless, they furnish a never-ending stream of reflective thought that opens up vast avenues of understanding that lead to higher Culture.

This book is not intended to be a learned treatise on Evolution. It is meant to be an introductory study—an outline, in the mysteries and harmonies of Nature's laws. It is written by a layman for the laymen. If it has added one new thought to Cultural Evolution, its purpose has been accomplished. *CHAS. W. GRIMES.*

Tulsa, Oklahoma.

January 5, 1937.

CONTENTS

Chapter	*Page*
I—Evolution in General	11
PART ONE—CULTURAL EVOLUTION.	
II—The Dawn of Civilization	25
III—Developing Into Social Order	36
IV—A Written Record of Achievements	49
V—Evolution of the Alphabet	59
VI—The Developing of Morals	68
VII—The Developing of Transportation	80
VIII—The Developing of Communication	93
IX—The Developing of Power	106
X—The Developing of Art	119
XI—Developing the Art of Music	130
XII—The Unity and Application of Art	139

Part Two.

Chapter *Page*

XIII—Organic Evolution 153

XIV—A Little Astronomy and Geology..... 164

XV—The Beginning of Life..... 171

XVI—The Preparation for Higher Life..... 182

XVII—Complex Life—The Invertebrates..... 192

XVIII—The Reptiles..... 199

XIX—Coöperation of Plant Life..... 208

XX—The Birds 216

XXI—The Mammals 222

XXII—The Evidence Furnished by Embryology..... 234

XXIII—The Evidence Furnished by Anthropology..... 242

XXIV—Casting Off the Useless Organs..... 256

XXV—The Life Spark and The Soul Spark..... 268

XXVI—What the Future May Develop..... 278

A Story Outline of Evolution

CHAPTER I.

Evolution in General.

EVOLUTION is the story of life from the first living cell to the present time. It is Nature's story of the history of life with its successive changes. It is a logical story of the method of creation based on scientific facts. Its fundamental principles have been weighed in the balance of reason by many thousands of trained and capable investigators in every branch of Science. It shows the developing of Nature's negatives so that we can see the unfolding of the real pictures of life's growth. The purpose of this growth is to reach a higher plane where the struggle for existence may be more easily overcome. It lifts the veil of mystery from the mythical suppositions of life's processes and presents them as a harmonious working order each directed to the creative whole. It is a history of the sum total of many thousands of connecting facts, all in complete harmony, that cannot be reasonably explained in any other way.

All great discoveries add to the universal knowledge and understanding of the mysteries of Nature. The principles back of these discoveries have always been the same. The principles of steam, electricity, the telephone, radio, television and all other great discoveries were of little value until they were applied to the uses of man. It is a knowledge and application of these principles that make them useful. Throughout the ages, the principles of Evolution

have been the same. These principles have surrounded all men of all ages but they could not see them until great thinkers had woven them together and proved that the powers of Nature are working through a universal method of growth. The veil of mystery has been lifted and we now see the workings of Nature as they really are.

Prior to about seventy-five or eighty years ago, the great Sciences were being studied as separate and independent branches of knowledge with no thought of their dependence and relationship to one another. But long prior to that time, the gentle waves of human thought had begun to quicken and to concentrate on the origin of species. Aristotle seems to have caught the first nebulous mental flash of the principle of natural selection. Goethe in Germany, Geoffrey Saint-Hilaire in France and Dr. Erasmus Darwin, the grandfather of Charles Darwin, in England, had reached approximately the same conclusions in 1794-1795, namely, that species undergo modifications and that the existing forms of life have not been perpetuated since the origin of all things. Lamarck of France in 1801, then in 1809 and again in 1815 had thought out crude and imperfect outlines asserting that "all species, including man, are descended from other species." From this time on until 1859, a score or more of naturalists in Germany, France, England and the United States added their contributions to the unorganized scientific thought of the world concerning the materials and the powers of Nature action.

Charles Darwin after twenty-two years of intensive study and research work published, in 1859, his famous book on the "Origin of Species." This book quickly crystal-

lized scientific thought toward Nature action and the separate Sciences were quickly woven into the fabric of the creative whole. This book revealed the fact that there is a universal method of growth and that all Nature action is governed by laws in perfect harmony with the entire plan. It was through this mental achievement that Charles Darwin is regarded by most great thinkers as one of the greatest thinkers of all time. His conclusions form the fountain head and reservoir where our organized knowledge of Evolution began.

The waves of human thought now became like unto a mighty sandblast cutting away the very foundations of human beliefs. No other book ever printed has aroused so much controversy among thinking people. No other subject within living memory has so challenged traditional beliefs, revolutionized the world of Nature and moulded, congealed and crystallized human thought as has that of Evolution. It has been on the firing lines of controversy for three-quarters of a century. Bitter controversies raged over the principles of Evolution throughout the entire world. It challenged the traditional beliefs in the method of Creation and world-wide traditional beliefs are not easily broken down or destroyed. These attacks have only served to make it stronger and more easily understood. Instead of yielding ground, it has advanced to a point of almost universal acceptance among thinking people. Its chief credential lies in the fact that its principles are persuasive, convincing and unanswerable and that no imagination of man could have developed a story so wonderful, or worked out a plot so intricate and complete and that at the same time

so harmonious and simple. And yet today the typical person of fairly liberal culture is deeply ignorant of its plan and blind to its harmony and beauty. For him Evolution is no part of his intellectual training. He has not been schooled in its principles. To the average person, it means that man has descended from a monkey.

Traditional beliefs cannot be easily changed. They are still defended after the traditional interpretation is proved by reason to be fallible. Every new thought which has added to and brought about the advancement and progress of our civilization has met with opposition if it interfered with a traditional belief. When Jesus of Nazareth appeared upon the stage of human action teaching a new philosophy of life, he was persecuted and crucified for his teachings that disturbed the old order of things. When Paul, one of his followers, went about proclaiming those same teachings and doing all in his power to elevate humanity, he was imprisoned, scourged and beheaded. When his pupils attempted to follow the precepts which he had taught, they were crucified, burned and torn to pieces by wild animals before a blood-thirsty mob in the Roman arena. These terrible butcheries were so frequent and so numerous that the seats in the Roman arena were sprinkled with costly perfumes in order to overcome the stench of human blood and gore. Socrates, the greatest of the Grecian philosophers, was condemned to death and forced to drink a cup of poison because he would not believe in the mythical gods of Greece and because he taught the youth of Athens that these mythical gods had no divinity. When Gallileo first taught that the earth is round instead of flat, as was the traditional belief,

he was threatened with death and forced to retract his heresy because the Bible spoke of "the four corners of the earth." For many centuries, many millions of over credulous persons believed that a woman has one more rib than a man has. The church taught this doctrine.

Seventy years ago, there appeared a front page news item in a Boston newspaper, under the caption, "Swindler Exposed, New York Authorities Uncover Gigantic Fraud," the story quoted is as follows: "A man about 46 years of age, giving the name of Joshua Coppersmith, has been arrested in New York for attempting to extort funds from ignorant and superstitious people by exhibiting a device which he says will convey the human voice any distance over metallic wires so that it will be heard by the listener at the other end. He calls the instrument a 'telephone,' which is obviously intended to imitate the word 'telegraph' and win the confidence of those who know of the success of the latter instrument without understanding the principles on which it is based.

"Well-informed people know that it is impossible to transmit the human voice over wires as may be done with dots and dashes and signals of the Morse Code, and that, were it possible to do so, the thing would be of no practical value. The authorities who apprehended this criminal are to be congratulated and it is hoped that his punishment will be prompt and fitting, and it may serve as an example to other conscienceless schemers who enrich themselves at the expense of their fellow creatures." This statement was made within the memory of those still living. The above, no doubt, reflected a popular view at the time when it was

printed. The reader thereof today, in the light of the great development in communication, is amused. The subject of this notorious "swindle" is today almost a household necessity. We may now talk from the very location where the above statements were written to all the leading countries of the world and also to the great ships at sea. With the 18,000,000 telephones in this country, with the 12,000,000 radios and the beginnings of television, it is probable that the generations which will follow us seventy years hence will be amused at the crude ways we are doing things now.

Following the invention of the automobile, some cities passed ordinances forbidding the use of automobiles on the streets because they frightened the horses. The inventor of one of the best known makes of automobile, whose name is a household word, told the "City Dads" in his city that the day would come when automobiles would drive all the horses from the streets in all the cities. This prophecy was made only thirty-two years ago and how true it was can best be proved by driving an automobile through the congested districts of any of our large cities today.

Hundreds of such examples might be mentioned showing the force of traditional beliefs. There have been innumerable traditional beliefs forsaken as our knowledge of things has increased and as our civilization has advanced. It must be remembered that it matters not how many beliefs there may be or how universal they are, belief alone cannot establish a scientific fact. Unless beliefs are founded on Truth, they cannot permanently endure. They must adapt themselves to the changing order as Truth unfolds.

During the past three generations, Evolution has been subjected to the most searching and bitter criticism, both honest and biased, of any subject of world-wide interest that has claimed the attention of thinking people. It has withstood the test of all these criticisms and after each new attack, it has emerged with more impregnable armour than before. It invites honest and intelligent criticism. There is nothing to be gained in its defense except that reward that is gained in the defense of Truth.

Evolution may be properly divided into two general heads, *viz.*, 1. Organic Evolution, and 2. Cultural Evolution. Organic Evolution treats of growth and changes of all forms of life in both the plant and animal kingdoms from the life that stirred in the first protoplasmic cell millions of years ago down to the present time. It is the indelible record of the physical changes and methods employed by Nature in bringing about the present stage of perfection in all forms of life. Cultural Evolution treats of the changes that have been wrought through and by the mental processes of man's brain. It is a record of man's adaptation and use of the material things about him as aids in his struggle for existence. It is a record of his achievements in harnessing the forces of Nature and making them obedient to his will.

All the knowledge which we have comes to us through our special senses and deductions and also from the personal experience of human beings that they have in some manner imparted to us. A vast multitude of earnest workers have devoted their lives to a careful and methodical study of the laws of Nature in an effort to solve Her mys-

teries. We call this great body of patient toilers—scientists and the results of their work—Science.

Science is merely classified knowledge—a catalogue of Truth. This great multitude of scientists have spent and are spending their lives questioning, observing, testing, measuring and comparing innumerable fragments of knowledge and building them into an orderly coherent story of the whole plan of Creation. Each fragment of knowledge is subjected to the severest tests. It is forced to withstand trials and experimental tests based on the experiences of all men of all ages. If it is found to be a part of Truth, it then becomes a scientific fact and is catalogued as such.

To know the truth is the greatest ambition we can have for it is the most satisfying and substantial thing there is. It cannot be purchased and can only be known by continued, persistent and sacrificial work.

Science deals only in facts. In order to know the workings of the things around us, we must know Evolution. We cannot know Evolution without knowing Nature and we cannot know Nature without knowing it as Evolution's story of Creation.

Evolution's story cannot be told without an explanation from the workshops of the scientists for they embrace its all. It is the patient toil of these scientists that makes Evolution's story complete. We go to the workshops of the geologists and find them in the quarry, on mountain tops, in canyons and river valleys, with pick and shovel, core-drill and microscope. They tell us that the earth is thousands of millions of years old; that they have divided the age of the earth into geological divisions; that the shortest period of

time of any of these ages is hundreds of times as long as the whole of history; that life has been on this earth for a period of, perhaps, a thousand million years; that by probing down into the earth, they find that the deeper they go, the simpler are the forms of fossilized life revealed there, until finally no life can be found at all.

We go next to the workshops of the botanists and we find them in the garden, on mountains and in the valleys, in the deepest jungles, studying the plant life of this world. They tell us that some of the plants are our friends and some of them are our enemies; that all animal life lives and is dependent on plant life; that all plant life is struggling for existence and adapting itself to its surroundings; that there is fossilized plant life the same as fossilized animal life; that plant life is older than animal life and that the deeper down in the earth's formations they go, the simpler plant life becomes, and finally no plant life can be found at all.

We then go to the workshops of the biologists and we find them in their laboratories with microscopes, test tubes and culture pans studying the forms of life, how they are builded up, and the uses of their different parts and their relation to each other. They tell us of the kinship between plants and animals; of the myriads of animals that cannot be seen with the naked eye; of the grouping of the cells; of the foods they eat and how each part is related to the whole, each performing its separate, yet, related function.

We go next to the workshops of the physicists and we find them in their laboratories surrounded with all kinds of delicate instruments—measuring the speed of light, study-

ing matter, energy, atomic weights, electrons and everything the earth is made of. They tell us that within each cell there are millions of molecules; that within each molecule, there are millions of atoms; that within each atom, there are millions of electrons, each traveling around its nucleus, like the earth around the sun at a speed of hundreds of miles each second.

And then we go to the workshops of the astronomers. We find them in their observatories peering through huge telescopes and surrounded with many measuring devices. They are studying the movements and structures of the planets and stars. They are calculating the time of each eclipse of the moon and sun to the exact minute a hundred years hence. They tell us of the unmeasured immensities of space; that light travels more than 186,000 miles per second and that it takes 100,000 years for light to pass from the "Milky Way" to the earth and that the space beyond the "Milky Way" is millions of times more extended than is the space between the "Milky Way" and the earth; that the nearest star is 25 trillion miles away; that there are billions of stars; that all heavenly bodies are moving through space in accordance with certain fixed and unchangeable laws; that their movements are so accurate and well-balanced that every leaf that falls from a tree affects the movements of the most distant star; that the same law that guides the electron in its orbit, holds and guides the planets in their courses; that space is limitless and that time is eternal.

After visiting these various workshops and many others, and seeing that there is a harmonious Plan of Creation

extending from the first protoplasmic cell to the most distant star and that all things are related to one another and are living under the same universal laws, we are convinced that nothing that lives on earth has come by chance. That there is a great creating, controlling and directing Power back of all things, in all things and above all things which we call God. These scientists do not dispute this Power. They recognize this Supreme Power. They are searching to discover what God has done and is doing, how it was done and why it was done that way.

There is nothing in Evolution that challenges the vital truth of religion or that contradicts the true principles of Christianity. Everything in the Bible story of Creation relates to questions effecting the order of the natural world except the first verse of the first chapter of Genesis which declares that—"In the beginning, God created the heavens and the earth." Evolution does not challenge this statement. It admits that all finite existence has been called into being by a Power which transcends the finite. It must be admitted that a Power that has developed all life from the lowest forms that we know to the present forms of life could have created all life in its present forms as easily in an instant as in a thousand million years, but such was not the method chosen. Evolution is concerned with the methods which the Creator has actually pursued. It, therefore, is not the enemy of religion, for Mental Evolution embraces all of religion. The many evidences of Evolution are the only scientific proofs of a directing and divine Creator we can have. The harmony of Creation is the means man uses to justify his religion.

We know that every living thing had its origin in a single cell and that its method of growth has been through processes of addition, multiplication, subtraction and division. The powers of reason show us what the present method of creation is and these same powers show us that this method has never changed. When man has learned that all life has come from the lowest forms known and that the universal order has been purpose, design, harmony, work and growth; and that he, himself, stands at the head of all forms of created life; that his intelligence is a part of the Universal Mind; and that he can put his mind in tune and harmony with the Infinite Mind, then his religion is justified by Evolution.

It is only reasonable to assert that it is easier to follow the verdict of our God-given intelligence than it is to defend a fallible interpretation based on traditional belief.

PART ONE

Cultural Evolution

CHAPTER II.

The Dawn of Civilization.

THE earliest evidence of mental action is found in crude flint chips wherein primitive man sought to make a sharped edged or cutting instrument. Civilization had taken its first step when the human brain conceived the idea of making and using some tool to aid him. So far as positive present records go, this was the beginning of reason. All the progress, culture and achievements of the human race are built around this first step, but before this step was made, much preliminary work had been done.

The laws of Nature demanded that all life be developed and sustained by certain of the elements or combinations thereof. The fundamental and necessary requisites of human life are food, water, oxygen, clothing and shelter, the last two of which are dependent largely on climatic conditions. So far as human habitation is concerned, oxygen is the only one of these necessary requisites that is universal and is found in all parts of the world where human life is found. The others may be transported to places where they do not exist and there used. Nature has supplied all those requirements in one form or another and it is through the processes of adaptation and selection, modification and change that their uses are applied to the necessities of mankind.

Wild creatures obtain their food from the store houses of plant life or from other creatures whose bodies are built up from such store houses. All animal life, whether herbivorous, carnivorous, or insectivorous ultimately depends on plant life. The wild creatures take their food as Nature has prepared it for them. Instinct teaches many of these that Nature is not always generous with food supplies suitable to their existence throughout all seasons of the year and that it is necessary for them to store away the excess of food supply for their use during periods when Nature is resting. This is a necessary expedient with many species of birds, animals and insects in their struggle for existence. However the creatures that have been domesticated by man have learned to rely largely upon him for their food supply.

Nature has taken care of the lower order of creatures by giving to them protective coverings for their bodies suitable to meet the conditions of their environments. The warm-blooded animals have coats of hair, the birds have feathers, the fishes scales and the lower orders protective shells, all adapted to the greatest degree of protection for the environment in which each passes its existence. These protective coverings are not sufficient to protect these creatures at all times from the elements and from their natural enemies and, because of this, they have selected and constructed shelters as additional methods of protection.

The vestigial organs of the human body bear evidence that primitive man and his primitive ancestors relied upon the raw products of Nature for their food, the hair covering their bodies for protection, and the trees, caverns of the earth and other protected places for shelter, in the same

manner as do the lower animals today. They were then as we are now both herbivorous and carnivorous in their use of foods and they were gregarious and migratory in their habits. As an additional protection against their enemies, it is not unreasonable to suppose that their special senses, like the wild animals of today, were more highly developed than they are now in this artificial age where protection against savage beasts or savage men is no longer a necessity.

In the early periods of man's existence, his foods consisted of the uncultivated products of the open plains and forests, life from the lakes, streams and the ocean, and the animals he was able to kill. Those living along the water courses and the ocean made use of the clams, fish, oysters and all other forms of aquatic life that they could acquire. Judging the past by the lowest order of human life found today such as that of the Australian Bushmen, it is reasonable to assume that he also made use of worms, bugs and grubs as a part of his daily diet. As early as the late Palæolithic Age, he had learned the art of making harpoons for spearing fish. Wild berries, grain, nuts and the early forms of all of our fruits and vegetables were used for food. He was particularly fond of the marrow from the bones of the animals and the uncovered rubbish heaps of Mousterian man show that the bones of the large animals had nearly all been split or cracked in order to secure the delicious marrow. Whether this was a matter of necessity or taste we do not know, but the fact remains that it was a common custom among the early tribes.

The teeth of early Mousterian man furnish evidence that he ate the buds of trees and plants much in the same

manner as do the grass eating animals of the present time. He had no idea of game preservation and protection and the eggs of birds and waterfowl furnished him with another item of food. For unknown centuries, the flesh of the beasts he killed was eaten raw. Doubtless, much of this was in a putrid condition. Like the animals of today, the stench of putrefaction was pleasing to his sense of smell. At a period dating back some 25,000 years ago, we find the ashes of his hearth fires and a cupped out stone which was the beginning of the grease lamp. This is evidence that he had begun to cook his food and to use the animal oil for lighting purposes. He doubtless rendered out and preserved the animal oils in order that his cave dwellings might be made a more cheerful place in which to live. Many of the carvings on cavern walls depicting now extinct species of animals, could have been made only by the use of artificial light. His mind had reached a stage where it was restless and craved action. While he was hemmed in from the winter's storm, he found relief in painting or carving the pictures that clung to his memory upon the cave walls or on pieces of ivory from the gigantic hairy elephant that fell a prey to his cunning. Little did he realize that he was leaving a record of his achievements that would be eagerly studied by his descendants, eager to learn something of his ways of living, 25,000 or 50,000 years after the record was made. His mind was as yet in an unorganized state and it required long periods of time for a change to come about, but experience was giving him new ideas which were being slowly tested out and put into action.

All growth and development are processes of addition, multiplication, subtraction and division. His ideas were added to, multiplied and divided and the useless ones were, in time, subtracted from his accumulating storehouse of knowledge and cast into the discard just as has been done in Organic Evolution. But through all these processes, progress was being made and no backward step was permanent. The impulse of searching for newer things had taken hold of the human mind and has grown and developed with each succeeding generation to the present time and it will continue to grow and develop until the processes of Nature are all uncovered and understood.

The urge of hunger has always developed an impulse with all creatures to seek its satisfaction. It was, doubtless, from this impulse that primitive man first began to use primitive weapons in securing his food. Many authorities agree that the first weapon used by man was a club. With this he could strike a more deadly blow than could be done with his hands or teeth. The first implement or tool which he used was a sharp edged flint which served as a knife for cutting purposes. He learned that he could crack nuts or the heavy bones of the animals he killed with a stone easier than could be done with his teeth.

He struck together two pieces of flint and generated a spark of fire. He learned that fire will consume wood and that it would warm him when he was cold; that it would give a fragrant smell and different taste to meat when cooked and which he had been eating raw. He learned that the skins of the animals he killed would protect his feet from the sharp rocks and thorns and his body from the

cold; that their bones could be cracked into splinters which he could use for awls in puncturing and sewing the skins together.

It is not definitely known how long it required primitive man to learn the use of these simple aids nor how far their discoveries are removed from the present time, but it is known from drawings on cavern walls, from images carved on ivory and stone, from man made implements found buried in ancient river beds and elsewhere that it was at a time when many animals now extinct, such as the mammoth, bison, wild horse, elk and other species roamed over Europe and when climatic conditions were far different than they are today. By applying all the knowledge acquired by scientific searchers to the evidence thus gathered many scientists place this period at approximately 200,000 years ago, while others place this period at more than double that length of time.

It was during this period of discovery that man first began to reason. It is the very dawn of civilization where man's achievements began. Beyond this point there is, as yet, no light that can penetrate the darkness to discover more of his mental actions. The fossil evidence in the form of crude flint chips and drawings mark the end of the road which our civilization has traveled. The form and structure of his body may be traced many centuries beyond this period, but his mental actions, at present, can not be further traced.

It is from these simple discoveries as a starting point that all of the mechanical devices have sprung. Securing food was a matter of life or death with primitive man. The many drawings on cavern walls of the dangerous and giant

beasts of his time bear evidence of the hazards of the chase. His inventive genius was directed to perfecting weapons that would give to him both meat and mastery in his struggle for existence. He learned that the giant brute force of the forest had to be met with the force of mind.

He soon learned that flint rock could be chipped into a sharp and pointed instrument and this could be fastened in the end of a shaft thus making a spear that could be stabbed or thrown into the body of a beast with deadly effect. This invention is still in use among all of the uncivilized tribes at the present time.

Man had no powerful organs of attack or defense or muscular strength sufficient to enable him to meet in combat, on an equal footing, with the wild beasts of the forests. Their superior strength together with their tusks, teeth, claws and horns gave to them an advantage and made him an unequal competitor in asserting right of possession to some favorite watering place or food supply. To overcome these advantages possessed by the wild animals, he had to depend on the quickness of motion and his ability to climb as a means of safety when pursued or attacked.

These advantages possessed by the wild beasts caused him to be on the alert against danger at all times. There was developed in him a cunning for the purpose of outwitting and deceiving his enemies. Many hunters of the present time use deceptive methods of luring within gunshot range the game they kill. The bull moose may be lured by imitating the call of the cow with a birch bark horn. Wild turkeys and ducks may be lured by artificial imitative calls. Many of the wild animals at the present time such as the

fox, wolf and many others have developed a similar cunning for the purpose of deceiving their enemies and of luring to them their prey. A fox, when pursued by hounds, will sometimes run into the midst of a flock of sheep and continue with them in circles over the pasture in order that the hounds may loose the scent of a fox's track. In other cases, where the hounds are pursuing a fox that has a mate, the foxes will exchange tracks in order to rest each other. This is accomplished by running together for a distance and then the tired fox will get into a stream of water and go down the stream keeping in the water and its mate will cross the stream just as it is approached, thus luring the hounds after the obliging mate. This "trading tracks" is accomplished in many other ways such as the tired animal jumping over a cliff while the animal's mate leads off in short steps along the top of the cliff. Many of the birds with a brood of young have developed the deceiving habit of fluttering off apparently with a broken wing in order to lure her enemy from her brood. Many other cases might be mentioned concerning the mental processes of dogs which transcend instinct.

Because the wild animals were superior in muscular strength and possessed more powerful organs of attack and defense, it became necessary for man to outwit and overcome his enemies by methods developed by his reasoning powers. This applies to a period when he had no heritage of achievements from the ages other than that of instinct. Experience had taught him that a club to horn, tooth or claw combat with the wild beasts was a dangerous undertaking and that he must devise some weapon with which

he could strike a more telling blow and at a farther and safer distance than could be done with a club.

The next step in primitive mechanical development was one of the most important that the world has ever known. It was the invention of the bow and arrow. Primitive man had learned that flint could be flaked and chipped into a sharp edged and pointed instrument and that this instrument could be fastened in the end of a shaft that could be stabbed or thrown into the body of a beast, thereby producing a mortal wound. A piece of flexible wood was bent into the shape of a segment of a circle and held in this position by a piece of animal skin attached to each end of the stick. This was the simple process of developing the bow. By using a smaller flint tipped shaft, the arrow came into being. By flexing the bow into a larger segment and by suddenly releasing the string, the flint tipped arrow could be thus propelled instantly and accurately for great distances. The use of the bow and arrow became the common weapon of all mankind. It was in use for unknown centuries in every part of the world where man has had a habitation. It was and now is used by every savage tribe of people, wherever found. It has been in use for a greater period of time than has that of any other weapon ever made. It was the weapon of war used by all the ancient nations. With its use primitive man could strike more death dealing blows and at a farther and safer distance than he could do with any other means at his command. It overcame the advantages of superior strength and size, of tusks, teeth and claws which the wild beasts possessed. It was the weapon that prepared the

world for civilization and gave to man mastery in the kingdom of life.

The fossil evidence of early human intelligence is brought to us through the imperishable tools and weapons that he made from flint. They were first made and used at a period of time when the geographic boundaries and climatic conditions of Europe were much different from that of today. They were made and used at a period of time when primitive man was still in the Mousterian or Neanderthal stage, part human, part animal, and while great herds of wild horses, bison, elk, the cave bear and the cave lion, the hairy mammoth, woolly rhinoceros and many other species of wild animals, now extinct, roamed over and occupied the European continent and adjacent countries.

The only weapons of attack and defense that he had were the flint knives, flint or stone axes, flint spears, and the bow and arrow. The law of the jungle was the only law he knew. It was the "survival of the fittest." When we consider that it was with these crude weapons that he established mastery and dominion over all the beasts of the forests that were larger and more vicious than any we know today, we shall then appreciate the force of the bow and arrow as a weapon and the part it has played in the advancement and progress of our civilization.

Scientists tell us that Neanderthal man roamed in vast herds over the greater part of Europe, England and Ireland at the time of the last Ice Age. At this time, England and Ireland were, perhaps as yet, a part of the continent. There is some evidence that he occupied what is now the valley of the Nile River in Egypt at a time when its surface geologic

strata was 50,000 years removed from the time of the first Egyptian Papyri Rolls.

There is a gradual evolutionary growth shown in the manufacture and use of all the primitive weapons and tools from the first crudely chipped implements to the horizon of history. New implements were added and forms were changed, but this period was so great and the growth so slow that vast periods of time intervened when no perceptible change can be noted. It is the purpose here to show that these crude flint implements and weapons represent the earliest mechanical devices used by man and from these first ideas of helpful aids there have grown the billion mechanical forces now in use. The most mysterious fact about all this development is that there had been more progress and improvement made during the past century than there had been during all the preceding centuries. Most of the ideas that have changed the manners and customs of the human race have been put into use within recent times. This change did not come until man began to study, understand and control the forces of Nature and to apply these forces to his daily work. Throughout the ages they have lifted the burdens of mankind that had clung to him, like a millstone about his neck. The sweating, aching, plodding toil of the billions of men and women who had crossed the stage of human action before a knowledge of these forces came into being, cannot be recalled, but a soothing, comforting thought comes to us, their descendants, from a school of Greek philosophers who taught that happiness comes from within and not from without.

CHAPTER III.

Developing Into Social Order.

THE human mind had reached a state of development wherein it had begun to reason from cause to effect and to understand the "reason why" of many things, but it was, as yet, in an undeveloped and unorganized state incapable of reasoning out a complicated problem. It must not be assumed that man's mind was a blank before he began to fashion implements of flint, for such is not the case. No psychologist has, as yet, pointed out a satisfactory dividing line between animal instinct or animal intelligence and reason, because they are blended together like the colors of the rainbow. Since mind has played a stellar part in the evolution of organic nature, animal intelligence must be called on to supplement instinct.

We do not desire to provoke an argument with the Professors, but when we consider that the ants and bees have colonies in which some of the principles of human social organizations are found such as slavery, sexual regulations, division of labor, customs of friendly salutation, centralization of resources, armies with officers, domestic animals, government distribution of food, capital punishment, etc., we may then wonder how far-reaching is the admonition of the writer of the proverb—"Go to the ant, thou sluggard, consider her ways and be wise," or what hidden significance there is in the proverb—"The ants are a people, not strong,

yet they prepare their meat in the summer." Are we to discover that these insects have a developed reason which is a part of the Creative Mind and which we, as yet, do not understand?

When the human mind became charged with and made use of the thoughtful experiences of others that were imparted to it, primitive man began to reason out complex problems and when man began to reason out these complex problems, his brain began to grow and the mists that had clouded his understanding began to disappear. He had begun to profit from experience and to study the cause and effect of things about him and to tell others about them with the few words at his command. The folds and convolutions of his brain began to develop and to increase and as a consequence, his forehead was pushed out and up. The particular fold that controlled his language or speech was particularly noticeable in its development at that time; but the development of the human skull from the gorilla-like eyebrow ridges and the low receding forehead and its inner arrangement and also the different ethnological ages of man will be discussed under the title of Organic Evolution.

The great undiscovered world lay before him but he had discovered some facts and, with these, he began to work. There were many billions of facts to be uncovered in the Universal Plan so that they may be seen and understood through the process of reason. Their cause and effect and their relation to each other were to become known as his mind developed and as his comprehension gained momentum.

Throughout unknown ages, he had depended upon the swiftness of motion and his ability to climb as a means of safety against the attacks of larger and more dangerous animals. He now met these attacks with a piercing sting from a sharp pointed and penetrating arrow. Instinct soon taught the beasts of the forests that he was a dangerous creature and that he should be shunned. This same instinctive impulse is seen in animals today. A rattlesnake by giving a warning alarm will sometimes stampede a herd of cattle on the western plains. A nest of hornets or bumblebees will put to rout the largest of both domestic and wild animals. The beast method of fighting is by the use of muscular force and the weapons which nature has given to them and when they discover that some other creature possesses an advantage that they do not have, instinct teaches them that retreat is the most certain means of safety. They have no pride of courage when the odds are against them.

Only when primitive man had reached the stage of development that he was feared, did he then become the aggressor. The flesh of his animal enemies became his food. Instead of being the hunted, he became the hunter. His task of securing food was now much easier to perform. The Chellean and early Mousterian races of men were more herbivorous than carnivorous but, then as now, environment doubtless played a large part in the food they used.

We have seen that he learned that with the use of a rock held in his hand, he could crack a nut or the large bones of the beasts he killed with greater ease than could be done with his teeth. This act was the principle of the hammer.

He learned that flint rock could be chipped into the shape of an ax, but that it was easily broken and that there were other stones such as hornblend and granite that were much tougher and less easily broken; that these could be rubbed into the shape and size that he desired and that by rubbing a groove around and into the stone, a handle could be applied thereto. This gave him the stone ax. With this he could strike a more powerful blow. It was a weapon of both offense and defense and a handy tool about his campfire. It also became a weapon of universal use throughout the world. It has gone through many forms in its development. The skill and patience of the workman who spent long hours and days in shaping and polishing these weapons, may be traced in varying degrees, the same as can be done with products made by modern workmen.

The stone hammer and stone ax have, in the course of centuries, been supplanted by hammers and axes of steel, but the principle of their use has not changed. In tracing the development of mechanical progress, it is sufficient to show the beginning and the present in the development of the mechanical aids which man has called into use. At first their size and the power of their blows were limited to human muscular force. Now, by utilizing a force of Nature in the form of steam, hammers are made that can strike a blow that will break a solid piece of steel thirty-six inches in thickness. The principle of the flint tipped arrow that could be propelled by a bow for a distance of three or four hundred feet, has changed to the instant expansion of explosives that will drive a steel shell for a distance of seventy-five miles. The sharp edged piece of flint that was, perhaps,

the first implement used by man, has developed into the knives of industry ranging from the pocket knife to every steam and electrical knife in use.

His body was covered with a heavy coat of hair that gave to him protection from the cold. Long centuries after he had learned to make and use implements of stone, a great climatic change came over the Northern Hemisphere. Great glaciers of ice came slowly moving southward. The tropical regions of Alaska that produced the great beds of coal that are found there were changed to fields of ice moving southward, carrying, rolling, grinding and smoothing pieces of broken granite into sand and boulders. These great ice movements move southward in America to a point as far south as the Ohio River, dropping their granite and rock boulders along their way. They completely changed ancient rivers and, in their stead, formed new ones that flowed in altogether different directions. The main body of this great ice floe in America found a resting place along the northern boundary of the United States where they melted and formed the Great Lakes. The same conditions were true in Europe. As the great ice floes came moving southward, there was the great migration of animal life toward the warmer climate where food could be found. Primitive man either remained or followed back his steps as the ice receded by melting. Evidence is conclusive that climatic conditions changed and that man and many of the animals adapted themselves to the changed conditions. In doing this, he sought the shelter of limestone caverns and other shelters and made use of animal skins for clothing. The hearthstone ashes of Mousterian man may still be

found. The change of climatic conditions was the necessity that caused him to rob other animals of their protective coverings and adapt them to his use.

When and how the art of weaving was invented, we do not know, but primitive man learned that the wool and hair of animals could be woven into cloth that could be used as a protective covering; that the bark of trees and the fiber of plants could also be made into cloth that would protect him from the cold. The skins of animals were shaped and sewed about his feet for protection against the cold and also against the rocks and thorns. But they were mostly handmade until a few generations ago, when the machine supplanted the hand loom and the cobbler's bench. Hand weaving is still in use among benighted people, but from these there have been developed the great textile mills and shoe factories which produce the cloth and shoes that furnish protection to human bodies in all civilized countries.

The caves and other natural shelters were not sufficient in numbers or space to accommodate and afford shelter to the increasing families or tribes, so necessity again demanded additional shelter which must be artificially constructed. Like the instinct that directs the beaver to construct his house in a particular way and the squirrel his nest, man began to construct crude shelters that would give to him greater protection from the elements. At first, animal like, these were very crude. He made use of the overhanging cliffs with the skins of animals used as a break against the wind and rain. He constructed lodges of stones loosely laid together and covered with bark, brush and grass. He made

use of poles tied together at the top and covered with the skins of animals.

His first idea in building was one of shelter and the idea of beauty in structure had not been conceived. He learned that flat, smooth stones could be more easily fitted together than round ones could be and that the rough, irregular stones could be worked into smooth, square, or rectangular ones; that mortar made of clay would bind and hold these stones together and that it would also shut out the cold air that penetrated through the openings. He made bricks of clay and dried them in the sun or baked them in heated ovens. With these he shaped his structures as he desired. He hewed great stones into shape and placed them one upon another until he had erected houses that would withstand the storms of centuries.

It was thus that the art of building was begun at a time which antedates the earliest written history. From these first ideas of shelter structures, there has grown the beauty and design of both ancient and modern architecture. From the single hut of stone, mud or grass, there have arisen the Pyramids of Egypt, the structures of Greece and Rome and the modern tall buildings of the American cities, with all the intervening designs of structures. Fancy is a fad and as fancy changes, the new gives way to the old and then returns again to the new. As ground space becomes more desired, additional stories are added and extended skyward and this will doubtless continue until the tensile strength of all building material shall have reached a point where safety commands that a halt be made.

There came a time in the history of man when his food supply began to fail. As his tribes increased, the herds of wild horses, bison, mammoth and other animals became more scarce. Upon these, he had depended largely for his food, and his mastery and greed drove them to extinction. The wild grain that he had gathered and used as a food was no longer found in sufficient quantities to supply his needs. He had noticed that there was a "struggle for existence" among the plants the same as there was among the animals and that the plants could be made to yield more abundantly when they were aided by his care. He therefore began to cultivate the plants that were suited to his use and to destroy the ones about them that were taking their nourishment from the soil, thereby producing greater yields than unaided Nature could do. Nature is an impartial mother that gives to all her children an equal chance.

Here again, his inventive genius was, from necessity, forced to devise tools with which to plant and harvest his crops. These tools were developed as their necessity arose. He had learned that the soil should be dug up and loosened before planting took place in order that the plant roots could more easily obtain their food and that moisture could be longer retained. The first agricultural tool, therefore, was doubtless a pointed stick with which he could dig and stir the soil. Naturally, the soil selected, like his habitations, was the productive alluvial soil of the valleys. The first permanent tool that he used for digging was a spade made from a broad, flat flake of flint fitted on the end of a stick. Other evidences are found which show that he also made use of horns of animals and large clam shells for dig-

ging purposes. It is not known what methods primitive man used in harvesting his grain before the use of iron came into being, but since that time, beginning approximately 3,000 years ago and continuing until 150 years ago, the hand sickle was the tool of harvest. The grain was beaten out from its seed covering with a hand flail or tramped out upon the ground and the chaff separated from it by the wind. It was then ground into flour by the primitive people through a process of rubbing it between stones.

One of the strangest mysteries of mechanical development is the small degree of progress that was made in methods of harvesting for many centuries. From the beginning of civilization to a period almost within the memory of those still living, methods of harvesting the most important article of food that has fed the hungry billions of men, had undergone but little change. However, the progress of the last few generations has more than balanced the equation of unprogressive time with unprecedented mechanical advancement by supplanting in turn the sickle with the hand cradle, the cradle with the mechanical mower, the mower with the self rake, the self rake with the self binder and the self binder with the combine that cuts, binds, thrashes and sacks the grain in one single operation, and this is now followed by the portable flour mill propelled by gasoline power that grinds the wheat into flour in the same field where it is produced. If our ancestors, a few generations removed, should again be permitted to view the advance that has been made by their descendants, their thoughts would be ———? we do not know. If we shall judge the future by the past, the generations living 500 or

even 100 years from now, will be discussing the crude methods we are now using.

Let us return again to the little clearing in the valley forest. Primitive man had no sharp edged steel tools with which he could fell the giant trees to make room for his little garden of grain, but he had learned long ages before that fire will consume wood and he set about building brush fires about them which were continued burning until their supporting trunks were eaten away and the trees fell for lack of support. He had learned that plants require sunshine and that the tall trees had crowded out their more feeble relatives in reaching after it, and that by destroying the trees, the plants that furnished him food would have a better chance.

As the clearings widened, the pointed stick, the flint spade and the clam shell hoe were no longer sufficient to stir the soil which it was necessary for him to cultivate in order to secure the necessary amount of food supply. Hand digging required long days of toil and muscular force and it did not meet the requirements of the growing tribes. He had tamed and domesticated some of the wild horses and used them in pursuing his game. He had also tamed and domesticated some of the wild cattle and these in turn had furnished him with a supply of milk. They each possessed greater muscular strength than man possessed and he now conceived the idea of using their muscular forces to aid him in his struggle for food. He fitted harness made of animal skin about their bodies and hitched them to a wooden plow and with this arrangement he

stirred the rich alluvial soil that yielded to him his daily bread.

It was thus that the beasts of burden came into use at a period many thousands of years removed from the time primitive man shaped his first implements from flint. Before this period, the only force he controlled was the muscular force of his body. After the use of iron was discovered, the wooden plow was supplanted by one made from iron. The leather harness for cattle was supplanted by the yoke and in this form the use of muscular power continued throughout unknown centuries.

At the period when man first began to use beasts of burden in his work, the herd instinct still clung to him but his village sites were taking on forms of barbaric life. He had tamed and domesticated horses, cattle, camels, hogs, goats, sheep, dogs and chickens. Wild game was becoming scarcer and more difficult to secure and by taming the animals and having them about him, and by cultivating the crops as he had learned to do, there was no necessity for periods of hunger and starvation. He adapted himself to the conditions of his environment just as people do today. Upon the grassy plains, he became the herdsman caring for his flocks, in the valleys, he became the farmer and the fruit grower, in the colder regions, he wore clothing made from skins or the cloth that he had woven, and in the tropical regions, he wore no clothing at all. His food also was regulated by climatic conditions and by his surroundings.

At about this same period of time, the custom of barter and trade came into being. The desire for private possession and ownership is an inherent human instinct. Some

members of the tribe were more skilled and could make better bows, arrows and spearheads than others could make, while others were more skilled in using them and were better and more successful hunters. Some were more skilled in the art of tanning hides and of making articles of clothing than others and so on throughout the entire gamut of primitive activity. This led to the practice of exchanging one article for another whereby both parties to the trade were benefited. One tribe, because of local surroundings, could produce something that the other tribe did not have and vice versa. This led to the establishment of a primitive commerce which has grown into the magnitude of the present world commerce of today. Thoughtful human experiences were being traded and exchanged. Helpful discoveries that tended to the advancement and progress of the human race were being woven into the fabric of our civilization. Each new thought that lifted the burdens from humanity and made man's struggle for existence easier, was adopted and put into use. But there were tribes that isolated themselves from thoughtful contact with their neighboring tribes and instead of marching with the crowd, they have either perished or now exist as the benighted peoples of the world, living in much the same manner as did their ancestors before written history began.

As the early tribes increased, they bound themselves into separate groups or states, each living under its particular environment, developing its particular manners and customs and also developing a separate language. They were, as yet, in a semi-savage or barbaric state but social, com-

mercial and political intercourse was being carried on among them. It was in this state of cultural development that the leading races of men were found at the beginning of written history.

CHAPTER IV.

A Written Record of Achievements.

THROUGHOUT the centuries of the social and cultural progress of the human race, nothing has changed but human thought. Forms and customs have changed but the substance remains the same. Every step of our advancement and progress has been first planned and designed by some human brain and then put into practice and use. Most of these thoughts have come from suggestions obtained through observations of some action of Nature when the idea is formed, and then the details worked out by experiment. When a thought takes on action and form and becomes of general use among mankind, it then becomes a part of our advancement and progress. It is then a heritage for the ages. From the time our primitive ancestors struck the first spark of fire from a flint and shaped their first bow and arrow to the present time, each generation has contributed something to succeeding generations which the preceding generation did not have.

Those of us living on the earth today, because of the accident of the time of our birth, were born into the world of a race of superior beings, superior in intellect, training and achievements. We were born into the world in an age of advanced civilization, of culture, refinement and progress. There has been left to us as a social heritage the thoughtful experiences of all men of all preceding ages.

The past three generations have left to all future generations more achievements in mechanical progress than all the preceding generations had done.

Mechanical progress, through the aid of the telescope, has lengthened our vision a million times. Through the radio, we can hear the human voice ten thousand miles away. Through the use of the X-ray and the microscope, we can see objects that no unaided eye can see. The human voice and human vision are both canned and preserved for future generations. By means of medical science, surgery and sanitation, human life has been prolonged so that every normal baby born has a life expectancy many years greater than the preceding generations had. With the aid of the airplane, we can transport our bodies through the air at a greater rate of speed than any living creature has ever traveled before. In this country we now have 30,000,000 automobiles, 18,000,000 telephones, 15,000,000 plumbing connections, 12,000,000 radios and many millions of other helpful devices that our grandfathers did not have. We have a billion lifeless mechanical forces doing the lifting, pulling, pushing, carrying and digging work that was formerly done by the muscular forces of man and beast.

But how did all these things come to be? Were they evolved out of man's inner consciousness without effort on his part, or are they the result of work, of adaptation, of necessity and of mental growth? The answer to these questions is obvious.

Man has divided his mental achievements into various groups such as History, Art, Literature, Science, Religion and Philosophy. These groups are sub-divided into many

other groups. Which of the above divisions of man's achievements has added more to man's happiness is a controversial question and not open to a discussion in a story of this kind. A comparison of the sub-divisions of the above groups may properly be made. The greatness of any subject is always to be measured by the influence it has over humanity—whether it affects all men of all ages and all men of all races in the same or similar manner; whether its use has been constant and continuous; and whether its effect has advanced man's progress and added to his happiness.

Applying the above test to the division—Art, the greatest contribution that the preceding generations have left to us and the one exercising the strongest influence over humanity above any other, is that of writing.

The invention of writing, a medium through which man's thoughts have been preserved and transmitted from generation to generation and through which his discoveries have been communicated to others at a distance, has made possible the passing from a state of barbarism to one of civilization. The collective thoughts of mankind throughout the ages have been preserved and placed before us through the art of writing. It alone, as no other agency has done, has made possible the continuous progress of the human race. All intellectual achievements are based on a system of communicating thought. Carlyle says, "Certainly the art of Writing is the most miraculous of all things man has devised. With the art of Writing, of which Printing is a simple, inevitable and comparatively insignificant corollary, the true reign of miracles for mankind commenced."

All men of all ages and of all races have had a language through which they could communicate their thoughts to those about them. All available evidence points to the fact that the growth of language was a slow and gradual process in its development and, that at first, primitive man expressed a thought by a single word, just as a year old baby begins to express its observations and desires by a single word. Just how the first spoken words were coined or what mental reaction caused one object to be associated with certain sounds of the human voice and another object associated with some other sound, we do not know. It is likely that he attempted to imitate with words many of the sounds of Nature that he heard.

It is an easy matter to trace the origin of the newer words of our language because they were called into being to express ideas. It is also an easy matter to trace to the parent languages the origin of most of the words in common use that have been borrowed from other languages because they also were called into being to express the ideas of the objects and actions which they represent. A few examples may properly be cited illustrating this statement, as follows: Evolution is a word of Latin origin. The prefix "e" in Latin means "out" and "volvo" means "to roll" or "to unfold." Then Evolution simply means "to roll out" or "to unfold." The English word "book" is probably derived from the Anglo-Saxon word "boc," meaning a "beach," a species of tree with a smooth white bark about a quarter of an inch in thickness. Tablets made from the bark of the beech tree were one of the substances on which written characters were inscribed by some of the ancient

writers. These characters could be easily carved on the bark of this tree with a sharp or pointed instrument and they were durable and could be preserved. As an example of the earnest desire of the ancient writers to find a substance upon which their thoughts could be recorded and justifying the bark of the beech for such use, there are in this country living beech trees upon whose bark names were carved more than fifty years ago and they can still be read. Our word "library" comes from the Latin word "liber," the inner bark or rind of a tree used for paper. Our word "paper" comes from the papyrus plant from which the papyri rolls of ancient times were made and upon which most of the ancient books affecting our civilization were written.

Since the papyrus plant has furnished the substance upon which a record of the ancient past has come to us, it is only proper to give, in some detail, at this time, some of the facts in connection with its usefulness. It grew in the swamp or marsh lands of Egypt, although it has long been extinct in those regions. It is now found only in Sicily and along the upper Nile. It grew in clusters of eight or ten pithy stocks coming from one root and it attained a height of from three to ten feet. Its stocks were triangular in shape and at their lower end they were about four inches thick. Its uses were many. It was used in the manufacture of baskets, boxes, boats, ropes, sails, awnings and matting. Its roots were dried and used for fuel. The pith of the plant was boiled and used as a food by the poorer classes of Egyptians. The most important use to which this plant was put and the one that now concerns us most was in the manufacture of a kind of paper

that still exists with the records thereon after a period of more than 5,000 years. This primitive paper was made by cutting the pith of the stocks into strips which were placed side by side on a flat, smooth surface and over the layers thus formed, a second layer was placed at right angles to the first. The whole was then pressed, dried and smoothed. The natural gum of the strips glued them tightly together. The sheets thus made were white in color when new, but like the paper of today they turned brown with age. The average lengths of these sheets were from nine to fifteen inches and the average widths were from six to nine inches, while in rare cases they were as much as seventeen inches in width. The finest papyri are found in the "Book of the Dead," where the sheets are fifteen inches wide. These sheets were doubtless constructed and cut to meet the conditions of trade just as paper is prepared and cut today. The sheets were often joined to make a roll. These rolls ran in length from a few feet to more than one hundred feet. The rolls used by the Greeks were seldom more than thirty feet in length while some of the Egyptian manuscripts were more than one hundred feet in length. These long sheets were wound on cylinders of wood or ivory in the same fashion as are our window shades of today. It was largely on these papyri rolls, thus made, that a record was made and kept and handed down to us giving in detail many of the earliest recorded achievements of man. Edward Clodd, in "The Story of the Alphabet," states—"The earliest known specimen of hieratic writing is a papyrus containing chronicles of the reign of King Asa, whose date, according to a moderate estimate of Egyptian chronology, is about 3580 B. C."

Babylon, Chaldea, and many of the ancient nations of western Asia left their records on tablets of clay in cuneiform characters. These tablets were made first into a form of stiff mud on which the cuneiform characters were inscribed with a sharp instrument and then the tablet was baked in an oven. Edward Clodd again tells us that the Babylonian writings "had passed the pictographic stage long before eight thousand years ago." Thousands of these tablets have been uncovered and their cuneiform inscriptions translated.

Papyrus paper was in general use in Egypt, Greece, Rome and other Mediterranian countries covering a period of more than 4,000 years. For what greater period of time it was in use, we do not know. It was not the only object or substance on which was written a record of man's activities in the early written history of civilization. Other substances and objects were used in the early days upon which man inscribed a record of his acts and conveyed his messages just as he does today. Inscriptions were made on oyster shells, wood, leather, and carved in stone and bronze, but the paper of commerce was made from the papyrus plant.

The papyrus plant is no longer found where it once flourished in such vast quantities. Its use continued in Greece until about the year 670 A. D. During the last few centuries of its use it was no longer joined or made in rolls, but instead the records were kept on sheets in much the same fashion as the sheets of music are kept today.

The inscriptions written on papyri rolls and clay tablets many centuries ago show a similarity of interests of people

of all times. They contain letters from kings to kings regarding state matters, subsidies, taxes, preparation for war and many others. There are letters from fathers and mothers to sons and sons to fathers, brothers to sisters, lovers to lovers, and friends to friends. The whole gamut of human interest is found recorded there.

One writes to a sister, telling her "To have my tunic properly made and let them put good measure on it and be generous in coloring." Helene writes to a brother reproaching him for not attending the funeral of another brother. Herochides is asked to "match a white velvet color and to purchase two dracham's worth." The request is accompanied by a gift of six quarts of "good apples." Dorion is asked to let his brother "hear about our bald-headed friend." Heratheon invites you to dine with him on the occasion of his examination, at his house, tomorrow, the fifth, at the ninth hour.

There are many letters—begging for money, notifying debtors to pay, tax receipts, notices to look out for escaped slaves, notices of the shipment of goods, complaint about a donkey driver buying some rotten hay, the purchase of ox yokes and manure, the prosecution of a woman handling contraband oil and many others.

We have learned that men were able to read and to write down their thoughts in a written language 8,000 years ago; and many of these thoughts have been handed down to us through characters inscribed on a kind of paper made more than 5,000 years ago. What a heritage these records are to us!

It is only reasonable to inquire what will the generations of man living in the year 7,000 A. D. be using as an enduring substance upon which to record their achievements for future generations?

The ancient peoples preserved a record of their daily actions and achievements on stone, clay tablets and paper by inscribing thereon certain characters which form words which are used to convey the idea or thought of the person who made them. A further investigation disclosed that these words are not the same as the words we now use; that most of the words we now use can be broken up into parts and these parts traced back to some other parent language from which they have been borrowed; and these parts may, in turn, be traced back to the grandparent language, or languages until our researches are lost in the darkness beyond the horizon of history. We, therefore, see that the words of our language have mostly come from older forms and that there have been many changes in both spelling and meaning before their present forms were developed.

A further investigation discloses that in remote times no abstract characters existed with which man could form words to express his thought, but instead, he used drawings and pictures as a means of expressing his ideas and of recording his achievements. These are the oldest forms of writing.

The general law of development is that thought tends from the concrete to the abstract. These pictures or symbols denote the object or idea as a whole which tells its own story. These pictures are, of necessity, limited in scope and are usually condensed means of expression. They could not

be made to express the myriad experiences of the human race. It is to these pictures, however, that we must look to the origin of the complicated systems of expressing thoughts in a visible and lasting shape so as to make them intelligible. As human experience broadened, picture writing gave way to phonetic writing, where the characters employed denote the spoken word or its elements, either syllables or single sounds, such as vowels or consonants. These picture writings were blended into symbols and signs which were at first ony conventionalized pictures. The Sumerians invented the cuneiform system of writing and this system was soon adopted by all the leading nations of Western Asia. This system of writing, likewise, originated in pictographs. It is a combination of idiograms, syllabic signs and vestiges of the picture writings that preceded it.

Necessity demanded and called into use a more definite and specific means of expression which led to the invention of an alphabet.

CHAPTER V.

Evolution of the Alphabet.

AN alphabet may be defined as a series of abstract characters used to represent the single sounds of a language. They form the words employed in expressing the ideas which the language as a whole conveys. These characters of the various languages form the vehicle of communication and the depository of all knowledge which has been acquired throughout the ages. Since primitive man scratched his first crude pictographs on some enduring substance, more than two hundred and fifty alphabets have come into being and have been used as a means of expressing and communicating thought. Of this number some fifty have survived and are now in use. About one-half of this number are found in India, where their use is both restricted and local. The remaining numbers are variations of three scripts representing Roman, Arabic and Chinese characters which are in use today. The one representing the greatest progress and the highest culture to which the peoples of the earth have attained is that of the Roman.

Until very recent years the method of teaching a child on entering its first year in school was to begin with the A, B, C's, the first three characters of our alphabet, which is made up of twenty-six abstract characters. It is with these twenty-six characters and also the abstract characters representing the numbers that the child must work during

his entire life because they represent the foundation of our entire educational system and are used alike by the beginner as well as the most advanced and cultured. The numbers of the various combinations that may be formed from these twenty-six characters are so great that they are beyond our intelligent comprehension. It is by their use that all the achievements of all men of all races and of all ages are communicated to us. They form the depository of all present knowledge and the working tools through which all future knowledge may be acquired.

It may be thought that it is an easy matter to trace down the origin of, and the changes in, each of the twenty-six letters of the alphabet used by the English-speaking races, but such is not the case. Their tracks may be traced along a fairly well-beaten road for a period of 2,500 years or longer, but beyond this, the road forks so many times and these divide again into dimmer roads and trails, branching in many directions, until, at last, they disappear altogether. Starting, then at the farthest end of the dimmest path, it may be said that there is no one place or time where the characters of our alphabet began and that a table of their derivations cannot be produced with any degree of certainty and perhaps never will be. On the other hand, all of these characters have sprung into being as a result of necessity and each has passed through many changes and adaptations in both form and meaning and has developed through centuries of slow and almost imperceptible growth.

The characters used in the English alphabet, with their various changes and modifications, can be traced to the Phœnicians, the trading branch of the Semites, but, beyond

this, we cannot go. It is here that the paths become so dim that they cannot be further traced with any degree of certainty. The Phœnician alphabet that was carried to the Greeks consisted of twenty-two characters, only three or four of which correspond in form to the letters of the English alphabet that is in use today. Apparently, some of these letters, and, perhaps, all of them, were meant to represent the names that had been applied to the objects or things about these ancient people. Their Aleph, meaning "ox"; Beth, "house"; Daleth, "door"; Jodh, "hand"; Kaph, "hollow of the hand"; Mun, "water"; Rosh, "head"; Shin, "tooth"; are examples of original meaning of some of these Phœnician characters. However, this does not establish that their origin is lodged with the Phœnicians.

Many scholars have attempted to identify the Phœnician letters with the characters representing Egyptian hieroglyphics. Emanuel de Rouge, a French philologist, sought to prove that the source of the alphabet was to be found in the hieratic characters as shown in the Papyrus Prisse, an Egyptian document. Canon Isaac Taylor, in his book—"The Alphabet," which is regarded as the most complete treatise in English on this subject, adopted de Rouge's opinion as to the origin of these characters; while, at a later date, E. Clodd, in —"The Story of the Alphabet," challenged and denied this opinion. Other writers have attempted to show a connection between the Phœnician alphabet and the cuneiform systems of Assyria and Babylon. The early Babylonian characters which are supposed to furnish evidence of the origin of the Phœnician alphabet are about 2,000 years older than the earliest Phœnician inscrip-

tions and they had been subjected to many changes during this time. There is evidence that the Phœnicians had trade intercourses with both the Egyptians and Babylonians, because some of the early Phœnician characters making up the Phœnician alphabet resemble in many respects some of the characters used by the early Egyptians and Babylonians. Trade intercourse between peoples of different habits and customs leaves certain distinguishing marks and influences borrowed each from the other.

It will suffice for the purposes of showing growth and development, to say that the present evidence points to the reasonable conclusion that the employment of a small number of signs to represent the elementary sounds originated with the Semites, of which race the Phœnicians were a branch, and that it is from this source that the English alphabet has come to us, with many modifications, changes and additions through the Greek and Latin alphabets.

The curtain of time has veiled the origin of the alphabet which we use in our daily life so that we can see through it only dimly, but beyond this origin, however remote, there was another system of communication known as picture writing, which was employed for unknown ages. This system was in use among all the ancient nations, but it was more highly developed and better preserved by the Egyptians than by any other of the ancient people. This pictorial system of writing is known as the hieroglyphic system and it furnished some of the oldest and most artistic writing in the world. Philologists have divided this system into three groups known as Hieroglyphic, Hieratic and Demotic, meaning pictogram writing, idiogram writing and phono-

gram writing. The pictogram embraces signs representing words, the idiogram representing ideas, and the phonogram representing sounds. The Egyptians invented and preserved, in all, approximately seventeen hundred of these hieroglyphs.

The cuneiform systems of writing consisted of wedge-shaped, arrow-headed characters that were inscribed on clay tablets, cylinders and monuments and doubtless on less enduring substances which were in use in Babylon, Assyria, Mesopotamia and, in fact, in all the nations of Western Asia. There were many forms of these writings and they served as a means of communication among these ancient peoples for a period of more than 5,000 years. The decrees of some of the ancient kings were written in inscriptions representing three languages showing that the cuneiform system had variations of form among the different nations. This system was, so far as we know, the first step above the pictograph system of communication. It was finally abandoned and supplemented by the more advanced, flexible and comprehensive means of expression afforded by the alphabet. After the alphabet came into being, the use of the cuneiform system became obsolete. These wedged-shaped characters served a large part of mankind as a medium of recording his doings and achievements for a period covering about one-half of all recorded history. The tragic thing that happened to this system was that after it went into disuse, the meaning and use of these characters was lost and for a period of more than 1,600 years, no one was able to understand or interpret them.

A further analysis of the above divisions of the hieroglyphics shows that a picture would tell the whole story at a glance. The modern cartoons are the evoluted forms of hieroglyphic expressions. But when the necessity arose to express ideas of abstract matters graphically this called for the use of symbols and the picture idea of language was modified. Symbols were used to express ideas and after centuries of advancement and progress many of these in modified forms are still in use. Almanacs still use the signs of the Zodiac which were used by the ancient Chaldeans. They use the symbols representing the new moon, second quarter, third quarter and the full moon, the rising sun, etc. Three balls hanging in front of a shop denotes a pawnbroker, a custom still in use and patterned after the custom of the ancient money lenders. A pole with spiral stripes denotes a barber shop which is a sign of phlebotomy or the act of bleeding. A wooden character in the shape of a watch hanging in front of a building denotes a watchmaker or jeweler. A wooden boot hanging suspended over a door denotes a shoe shop, etc. A trumpet and harp denotes sound and harmony and our modern musical notation characters denote music.

It is known that communications written in cuneiform characters were carried on between the kings of the various countries of Western Asia and the Pharaohs of Egypt for many centuries. These documents furnish valuable information upon the political and commercial relations existing between the ancient nations at that time. They treat on many subjects showing the customs prevailing in Egypt and Babylon among which were negotiations between kings for

the purchase and exchange of wives. They furnish us evidence that the cuneiform system of writing was used in Palestine 1500 B. C., thus spreading the legends of the older nations over that country centuries before Hebrew literature, as we know it, came into being. These communications were sent by messengers and were accompanied by interpreters as reference is made to these interpreters in many of the documents. Another item of interest is the fact that copies of these letters and documents were kept by the sender as an evidence of proof of what the original contained.

The English alphabet in use today is a lineal descendant of the Hellenic branch of the Phœnician alphabet from which has sprung practically all of the alphabets of the world. It is known as the "Roman type" because it came through the Latin from Italy. The Phœnicians were a venturesome, seagoing, trading people and they carried and left the influence of their alphabet in all the countries bordering the Mediterranean Sea. In its western course, the Hellenes were the first to recognize its advantages, imperfect as it then was. It came to them without definite characters representing the vowels, but this defect was supplied by adding separate letters representing the vowels, so that it contained a visible character for all the vocal sounds of expression.

They transposed the method of writing from right to left by writing from left to right. They worked it over, taking out and filling in, until it had attained a higher degree of perfection than it ever before had had. It must be remembered that there was physical separation, lack of

unity of purpose and political disunion among the Greeks or Hellenese, and for this reason it passed through many changes before it reached the degree of perfection above mentioned. There were forty local alphabets among these known.
people, which is evidence of its appeal when its force became

The Greek alphabet was introduced into Italy about the eighth century B. C., where it became the Latin and finally the alphabet of the Roman Empire. Here again, it was subjected to many changes and adaptations until it became the most important of all alphabets. It was passed on and adopted by the countries of Western Europe and then to us, still carrying vestiges of its growth through all of its various stages from the cuneiform characters of Babylon and the Egyptian hieroglyphs to the present time.

As human experiences broadened and as they were woven into a closer fabric of commercial and social intercourse, new ideas were formed that called for additional methods of expression. But ideas must be expressed in sentences and sentences are made up of nouns which are used to express the names of persons or things; of adjectives which are used to qualify or describe the things represented by the nouns; of verbs, used to express action, being or condition; of adverbs, used to modify the meaning of verbs, adjectives, or other adverbs, and so on through all the other parts of speech. Words grew in numbers faster than symbols could be made to represent them and there were many words that could not be expressed by the symbols then in use. This led to a modification of the symbols already invented and then in use and to a separation of many of

them into various parts so that each part formed a character, and each character, thus formed, represented a sound. These characters were combined so that they represented words. Words are dying out and becoming obsolete while other new words are being added to our language in about the same ratio so that the decrease is about offset by the increase. By adopting a series of twenty-six characters such as our English alphabet contains, we have a system, the combinations of whose characters may form many thousands of times more words than are now found in any dictionary.

It was thus that the alphabet was formed, but we know not where nor when. It may be said, with certainty, that it was not formed at any one place or at any one time, but like every branch of both Cultural and Organic Evolution, it is the result of necessity, adaptation, modification, change and growth. It has followed the Universal Plan of Creation.

In discussing the development of the art of writing and of the alphabet, the story of Cultural Evolution, by way of contrast, has been advanced for a period of at least 100,000 years out of its regular order. Before the age of writing had been reached, there were more serious problems to be met and solved. These problems had engaged primitive man's attention for unknown centuries before the necessity arose for a system of writing. The law of self preservation was his greatest urge and its impulse must be obeyed if he was to survive in the struggle for life.

CHAPTER VI.

The Developing of Morals.

IF we shall turn back the curtain of time and look down through the centuries of civilization to the very horizon of history, we find that man's progress has been many fold in its development. From the very beginning there have stood face to face within the lives of all mankind and within the councils of every state and nation two opposing forces each struggling for mastery in the kingdom of life. One of these forces, we call right, the other wrong.

The early history of our civilization is largely a history of countless, cruel and bloody wars brought about by some man or group of men seeking to live upon the fruits of other men's toil. Its early pages are crimson with human blood. The laws of the jungle are elevated to a degree of humaneness when compared with the tortures inflicted by man upon his helpless brother. His superior intellect devised methods of torture that no animal brain could conceive or inflict upon its helpless victims. His spirit of revenge had no counterpart in all animal creation and death alone would not satisfy the demons of his nature.

From the earliest date to which our knowledge of history reaches, the divine right of kings was asserted and marshalled against the common rights of humanity. The divine right of kings asserted: "You work and earn bread and I will eat it; I will compel you to do it with the sword;

might makes right." The common rights of humanity answered: "All men are created free and equal and have the right of life, liberty and the pursuits of happiness; right makes might." From the dawn of civilization, this struggle between right and wrong, between the divine right of kings and the common rights of humanity found a common battle-ground in the institution of human slavery.

Human slavery has existed from the beginning of history. In the early times, the men who were captured by an opposing army were tortured and killed in the most fiendish manner their conquerors could invent and their wives and children were assimilated into the tribes. After centuries of this fiendish butchery, the men who were taken as captives were kept as slaves for the king or state. The conquering kings learned that many of their captives possessed knowledge which they did not have and that they were more valuable than the common plunder of war.

The ego of these early rulers became personified and their ambition knew no bounds. They desired that their subjects should look upon them as one possessing the power of deity. In many of the early nations the only purpose of the rulers was that of self-aggrandizement. They were both mad for power and intoxicated with power and their subjects were forced to spend their lives on the fields of battle or in unrequited toil in carrying out the schemes of these rulers.

The pages of history are replete with records of their arrogance and cruelty. At Behistun, Persia, bas-reliefs cut on the face of a precipitous rock portray the scenes that were enacted there 2,600 years ago at the direction of one

of the well-known Persian kings. The effigy of Darius Hystaspas, bow in hand, stands with his feet on the prostrate form of one of his victims. Nine other captives chained together by the neck stand before him. Inscriptions carved in three languages on the rock tell the story of his heartless butcheries, how he slew his helpless victim and how another was tortured by having his nose, ears and tongue cut off and then crucified together with his associates. More than one thousand lines are carved in cuneiform characters telling of these exploits. These chronicles display the boastful ego of King Darius. The central thought is: King Darius did this and King Darius did that, etc. But this is only one of thousands of similar records portraying the mental state in the early written history of mankind. Other forms of torture are recorded that are so inhuman that it is better that they never again be repeated.

An amusing incident of stupid ego is the story of Xerxes, another Persian king, commanding that the water be whipped because the wind had rolled the water into waves that disturbed his ships. His ego was so great that he believed his will could control the laws of Nature, but his deluded mind discovered that the waves did not obey his commands.

The institution of slavery involved the greatest moral question that civilization has known. It doubtless existed long before the historic age. It was so universal in the early days that it was regarded by all as both regular and natural, but with the advancement of civilization this viewpoint has changed and no civilized country today recognizes slavery as an institution. The Bible tells us that God made a covenant with Abraham for the redemption of all mankind,

yet Abraham was a slave owner. Some of his slaves were "born" such and others were "bought with money." God called Job "his servant," yet Job was a slave owner. When Christ came into the world preaching a new philosophy of life, he found slavery on every hand, yet he makes no definite mention of the relation of involuntary servitude. Of a certain Centurian he said, "I have not found so great faith, no not in Israel," yet that man of such great faith was a slave owner. It must not be inferred that Christ's teachings did not encompass the wrong of slavery, for it did. He was dealing in spiritual matters which would correct all human wrongs when pointed out and followed. St. Paul condoned the institution of slavery by saying, "Slaves, be obedient to your masters." Onesimus was an escaped slave of Philemon. Both were converted under the preaching of Paul and Paul sent Onesimus back to his master. Martin Luther wrote: "He that says slavery is opposed to Christianity is a liar." It will thus be seen that the leaders of moral thought at the beginning of our Christian era and long thereafter accepted the institution of human slavery as a condition established in the social order of mankind. The early laws of many of the ancient nations permitted parents to sell their children into slavery and this was a common practice in Babylon, Assyria and other nations. These laws also provided that if a person borrowed money which he could not repay, the creditor, by due process, could make the debtor his slave. These added greatly to the slave population. They were bought, sold and traded as chattels the same as are domestic animals today. Only a comparatively few of the population of any of the ancient

nations were able to read and to write. The kings asserted authority over them and like dumb driven cattle, they had to obey. They had no other place to go. The nations would flourish for a time and then fall into decay and finally leave the stage of human action to be taken up and occupied by some other person who claimed and asserted the divine right to rule. The common rights of humanity, as yet, had no leader to point the way to greater freedom of action for the common masses. The common people had not, as yet, secured a charter guaranteeing to them their civil or political rights.

As the nations rose and fell and as our civilization advanced step by step, there appeared from time to time upon the stage of human action great characters whose lives and deeds have helped to shape the destiny of the human race. Superior talents and favoring circumstances have given to a few men since history began that special recognition which is called immortal by which their names and deeds have been preserved and transmitted from generation to generation and whose lives have furnished examples of inspiring, helpful deeds as models for our emulation. These few immortals since the beginning of our civilization have identified themselves with great human principles in which men of all ages and men of all races are interested. They have helped to advance the progress of civilization and to relieve the oppression and suffering of humanity. Their names have passed beyond their country, beyond their language, beyond their race and beyond the centuries in which they lived and now stand as guideposts directing the pathway of human progress. These immortals did not carve

their names upon the rocks or build great temples or pyramids, but instead, they wrote their names in deeds and acts, the effect of which advanced all mankind to a higher and happier state of existence.

Men began to reason that all men are of one flesh and blood and that each person has the right of life, liberty and the pursuits of happiness so long as he does not forfeit that right by violating the established rules of society, and that it is morally wrong for one person to enjoy the fruits of another's involuntary and unrecompensed toil. This idea was at first a nebulous thought but, like all other mental and physical changes, when set in motion, it began to take form and the nebulous idea became congealed and crystallized into the thought of the civilized world, thus becoming a force that rules the conduct of mankind.

Society began to establish rules guaranteeing to its members the rights of life, liberty and the pursuits of happiness. Society decreed that he who should take a life in violation of its rules, should, in turn, forfeit his own life as an example to others against a violation of this established rule. The time was when the rights of private property did not exist among the common people. The right of private property is a natural right. It is recognized by all forms of animal life. The beasts of the forests will fight over the right of possession of a watering place, over the right to use a cavern, or over some favored nesting place. They will protect their kill against other animals that had no part in the killing. Dogs will fight over the possession of a bone. Society established rules governing the rights of private property. It requires compensation for a violation of these rights and

provides a punishment for those who violate these rights. In Babylon and Assyria the right of slaves to hold, use and enjoy private property was recognized and regulated by law.

Political rights were the most reluctantly granted of all. Some rulers of vision with spirits of altruism, had, from time to time, granted their subjects certain civil and political rights and these rights would, in turn, be taken away by some future tyrannical ruler. These rulers were jealous of their power and sought to keep their subjects in a state of complete political subjugation. But as intelligence among the common people increased, the bud of liberty and freedom had swollen until the flower was bursting the bud. The people had begun to assert their rights and to demand that they be given a charter guaranteeing these rights to them.

England was ruled from 1190 to 1216 A. D. by King John, an illiterate, tyrannical, mean and cruel king. His tyrannical rule caused a revolt among his subjects which resulted in the granting of the first great charter of guaranteed liberty that humanity had ever experienced. The barons of England met and formulated their complaints and demanded redress of these grievances. It was not a request, but instead, it was a stern demand. At first the king refused, then procrastinated, and when he was faced with an army of his subjects ready to do battle to enforce their demands, he yielded and signed the Magna Charta in June, 1215.

He was furious and like a caged savage animal he tore his hair, gnashed his teeth, rolled his eyes, gnawed sticks and twigs, but there in a sheep pasture at Runnemede, on an island in the Thames River, he was forced to sign the

great document that was the beginning of the end of the principle of the divine right of kings to rule over the people without their consent. This was the first great triumph of the common rights of humanity. The chief promises exacted were—

1. That no free man should be unlawfully imprisoned, outlawed or exiled.
2. That justice should be administered to all.
3. That no taxes should be levied without the consent of the people.

The protection of life, liberty, and property from arbitrary spoliations by some tyrannical ruler who claims his right to rule is divine, is the most important feature of the charter. It may seem a long time since 1215 A. D., but the processes of evolutionary development are slow and "The mill of the gods grind slowly, but they grind exceedingly fine." This document was the voice of the people in the sheep pasture crying—arise and assert your rights; right makes might.

The seeds of liberty were thus sown, but the moral mind had not developed to a point of understanding that liberty and freedom are natural rights belonging to all men of all races and not alone to a particular race. For centuries the sons of the men of Runnemede were jealous of their own political and civil rights, but heedless of the rights of other races. This was an inherited idea for Aristotle defended slavery on the basis of "diversity of races." In both Greece and Rome in the later days no person could hold a slave of Roman or Grecian blood.

In 1776 the sons of the men of Runnemede, our forefathers, brought forth in a new continent another immortal document, declaring that: "all men are created equal; that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty and the pursuit of happiness, etc.," but it required eight years of bloody war to establish these rights in America. Human slavery existed in all the thirteen colonies when this Declaration was made and signed. After the war was ended and a government was being formed and a constitution adopted, all the colonies were slave owning colonies except that of Massachusetts. Most of the leaders of the new nation, including George Washington, Thomas Jefferson, James Madison, Patrick Henry and others were slave owners. Because of climatic conditions and industrial pursuits, slavery was unprofitable in the Northern States and profitable in the Southern States. Both Northern and Southern colonies were equally guilty for the slave institution in their midst. A number of slave vessels were fitted out by the Northern Colonies and were engaged in bringing slaves from Africa, but not one vessel was fitted out for this purpose by a Southern Colony. In 1778 the Colony of Virginia prohibited the further importation of slaves under heavy penalties. Georgia was the first of the states to prohibit the further importation of slaves by statute. Virginia pronounced the importation of slaves as "a trade of great inhumanity."

After the Revolutionary War was won, the government organized and the constitution adopted, the country began to grow and prosper. Freedom of action was greater than ever before experienced by any people. But the words of

the immortal Declaration—"all men are created equal"—began to burn within the hearts of the Revolutionary patriots. These words were either false or the free people were practicing not what they preached. As a consequence of this reasoning, the people of both the North and South began to free their slaves. The government census shows that in the year 1860 there were 268,817 free negroes in the Northern States and 247,817 in the Southern States, thus showing that the moral mind of both sections, population considered, was nearly in an even balance. As a corollary to the Civil War, the age old question between the divine right of kings and the common rights of humanity was forever settled on American soil. It was not a local or sectional question, but instead, it was a question of one of the moral thoughts of the ages that had passed through its evolutionary development and had crystallized into a force that regulates the conduct of human society.

Marriage is a social institution that is recognized by law or custom by all the peoples, both civilized and uncivilized, throughout the entire world. It is a natural relationship and is the outgrowth of the natural order of sex mating. Its counterpart is found among many other species of the animal kingdom and it has developed out of a primeval habit supplemented by instinctive laws of altruism. It involves certain rights and duties of the parties to the relationship and to the children born of it which the laws and customs of society uphold and enforce. However, these laws and customs have gone through many changes and modifications based on human experiences until they are now far different from what they once were. We are now con-

cerned only with the development of the moral idea concerning marriage.

Society has learned by costly experience that as a protection to the offspring, no marriage relationship should be permitted within the third degree of consanguinity and most all enlightened nations have laws prohibiting such marriages. But in the earlier times, such marriages were considered both regular and natural. Genesis tells us that the patriarch, Abraham, married his half-sister. The pages of ancient history are replete with examples of incestuous relationships. Again society has learned that polygamy and polyandry are conditions which are not conducive to the best interests of the nation and all the enlightened nations have established laws preventing such plural marriages. But many of the patriarchs of Bible history had plural wives. Wives were bought and sold as common chattels. Again society has learned that no marriage should be permitted between persons of tender years and all enlightened nations have enacted laws preventing such marriages, and yet most of the Oriental peoples permit marriages at the age of puberty or earlier. Not only this, but their customs have superceded the law of natural selection.

The same general rules of development are found in every human action belonging to the moral code and society has attempted to regulate the conduct of individuals to conform to established rules. The family is the unit of society. Parental teaching is the most effective of all teaching. The morals of no state can arise above the morals of the individuals comprising the state. It is the duty of the state to

establish rules of conduct governing the acts of its members in order that civilization may be advanced to the highest quality of life. This has been done through the evolution of its morals.

CHAPTER VII.

The Developing of Transportation.

EACH generation develops a group of men who fear no undertaking and who dare the impossible and prove it to be real. Their urge is a desire to shorten time and to eliminate space. They disdain to follow a traveled road and are only content in cutting out new paths of thought through the wilderness of the unknown. When the path is once well marked and the brush removed, the clearing, widening, grading and leveling work on the new idea is done by those who follow them. If the new thought is useful and helpful to mankind, it will not be relegated to the discard, but will become another highway over which our civilization may travel.

Human thought has not always been constructive. For unknown centuries most of human thought was destructive. It was devoted to planning methods to conquer and subdue some neighboring tribe or nation and the early aggressive wars were waged mostly for the purpose of conquest and plunder. The nations thus attacked, fought under the impulse of primitive instinct as a means of self-preservation. It was because of these prevailing conditions that so many centuries of the history of civilization passed without any great advance in industrial progress. Development cannot be had without adaptation to meet changing conditions.

In some countries there was such reverence for traditional customs that each generation would follow in the footsteps of their fathers and do as they had done and live as they had lived without any thought of improving the conditions of life about them. This was contrary to the laws of Nature for nothing in Nature is constant. Nature has decreed that there must be growth, and without growth there will be decay. Most of the ancient nations have passed across the stage of human action and have gone into the discard because they reached a point where growth was no longer found. This law applies to every living creature and thing that is found in both the animal and vegetable kingdoms and its positive proof may be found on every hand.

Mechanical progress, figuratively speaking, was in an infant state until man began to use the forces of Nature to aid him in carrying out his plans. One of the first problems that primitive man encountered was that of transporting his body and the objects that it was necessary for him to carry. By nature, he was not as fleet of foot as were many of the other animals, and swimming was an art that had to be learned. There were rivers and streams which he desired to cross that could not be waded and in order to overcome this obstacle, he constructed a raft of logs that would float and at the same time carry his body. This was the beginning of water transportation. The raft developed into the canoe that he learned to propel by the use of a paddle. He made use of the current of the streams that would carry his primitive craft down stream propelled by the force of gravity. The next step in water transportation was

the sailing craft, whereby he made use of the wind for motive power.

From these crude crafts there have been developed the great steam propelled ocean vessels, where all the modern conveniences of city life may now be enjoyed. Each generation adds to the convenience and safety of water travel some advantage that the preceding generation did not have. There is a sense of satisfaction and a halo of glory surrounding each new accomplishment. Each new accomplishment bears promise of other new accomplishments. Our primitive ancestors had little need for economy of time except in cases of emergency, but there were times when primitive man desired to transport his body at a speed which could not be attained by the use of his legs. Doubtless, the first time that he experienced the sensation of having his body transported at a speed beyond the natural limit of his own power of locomotion, was on the back of a horse. This was the beginning of the science of rapid transit, to which is devoted more time, labor, capital and inventive genius than is devoted to any other industry.

Until approximately 300 years ago traveling in Europe and in England was usually done on foot or on horseback. In 1662 there were only six stagecoaches in all of England. Prior to that time the Hackney Coach and the Cabriolet had been in limited use, but these means of travel were luxuries for the rich which the poorer classes could not afford. The Hackney Coach was a boxlike affair with firmly attached shafts protruding from both the front and the rear. It had no wheels or running gear and two horses with harness resembling pack saddles were placed between the

shafts, the one in front with its tail to the front end of the coach and the one in the rear with its head to the rear end of the coach, and with this arrangement the coach was carried. The driver walked by the side of the front horse. The Cabriolet was a two-wheeled cart resembling the Roman chariot, but the driver rode one of the horses in order to make more room for the occupants of the cart.

Prior to the coming of the stagecoach, there were no public highways—only trails leading from one place to another in the same manner as new trails are made and followed in all new countries. There were no bridges and even these trails were at times impassable. As mail routes were established and as the necessity for exchange and conveyance of goods and merchandise increased, a road building program was carried on to meet the requirements of the growing needs. Just as the stagecoach called into being a program for road building among all progressive people, so has the automobile during the present generation called into being the greatest road building program that civilization has ever known. New thoughts are always in the crude, but when a new and helpful thought is developed as a basic idea for the advancement of some branch of human culture, it is added to and improved upon to meet changing conditions. The necessity for rapid transit has developed new engineering skills, modern power driven road building machinery and bridge construction that have eliminated curves and grades, bridged rivers and chasms and tied the entire country together with solid concrete slabs. There has been more road building in the United States during the past twenty-five years than there had been in all its pre-

ceding history. As a result of this, the entire country has become one big neighborhood. With the improved roads and the automobile, time and space have been eliminated to a degree undreamed of a generation ago.

An overland journey that only two or three generations ago would be planned for months in advance and would be the occasion for making a will and the gathering of the neighbors to bid farewell, may now be made in a few hours with as little thought or concern as our forefathers had of making a trip to the mill.

Following the stagecoach, but before the coming of the improved highways and the automobile, there came into the industrial life of mankind the first steam railways, which did more to advance the commercial interests of all countries than any other invention has ever done. Before the coming of the steam railroad, tramways with wooden rails and with coaches drawn by horses were used to some extent in England. The first steam propelled carriage that ran on the public highways without the use of rails was constructed in France in 1769 and used on the public highways near Paris. Its average speed was two and a quarter miles per hour, and it had only three wheels, the driving wheel of which was guided in a similar manner to that of a bicycle. The next year another steam carriage was made which was used on the streets of Paris and when it overturned at a street corner, both the machine and its inventor were seized by the police.

The usual speed of travel in the early stagecoach days was from two to four miles per hour. After the early road building campaign was completed, a speed of ten miles per

hour was attained on the smoothest of the highways. This speed was considered extremely hazardous and necessitated the frequent change of horses.

The first public steam railroad to be constructed connected Stockton and Darlington in the county of Durham, England, a distance of eleven miles. On September 27, 1825, the first train propelled by steam power made its initial trip over this new road. George Stephenson was the man who invented, built and piloted the engine on the epoch making trip. It had a speed of ten or eleven miles per hour and, then as now, an epoch making event was the occasion for the greatest of interest among the people. The road was constructed for the purpose of hauling coal and the cars were not much larger than a farm wagon, but twenty-two of the wagons were filled to capacity by people anxious for the first trip. In addition to this load of human freight the little engine also pulled twelve wagons loaded with coal on this initial trip. The steam railway as a freight carrier was now established, but the persons who had taken their first train ride now began to demand that they be taken regularly. This led to the establishment of regular passenger train service and as the era of railway building continued, the day of the stagecoach began to wane. The basic idea of a new method of transportation was put into motion and through growth, development and adaptation the continents have been girded with steel rails.

The steam railway and steam navigation have developed the commerce of the world so that the people from the utmost parts of the earth may use and enjoy the products produced by the people from all other places. The naked

ivory and rubber hunters from the jungles have learned that they have products that can be exchanged for some useful article manufactured by those living on the other side of the earth. The trapper living within the Arctic Circle may exchange his pelts for sugar and coffee from the equatorial regions. Transportation at one end may be accomplished in snow shoes and the dog sled and at the other by carrying on head or back or in a dugout canoe, the hazards being equally divided, but rail transportation and steam navigation join these extremes into a common artery or trade channel. This is a development of the idea of barter and trade that was begun within the tribes of primitive man, and then extended to other tribes and continued until all the world is joined together as one great tribe of traders.

The idea of aerial navigation was a dream of thinking people from the days of the Psalmist to the time of its accomplishment. In the early days people were overawed by their superstitious beliefs. The superstitious people could conceive of more impossibles than a modern fiction writer. The belief in witches and ghosts that could ride upon the wings of the wind was a common belief among the ignorant classes two or three centuries ago. Incredible stories were told, believed and magnified as they were again retold. Even the more highly educated classes were not free from many superstitious beliefs. The mythological stories of all the ancient people doubtless had their inceptions in dreams brought about by overgorged stomachs and which left such impressions on the ignorant minds that they ascribed reality to them.

The principle of the aerostat, or passive balloon, was discovered and the ignorant believed that this furnished a key to the method of travel used by the witches. In Ministre's "History of Lyons," an account is given of what appears to be the first recorded instance of aerial travel. The record is silent as to the exact nature of the conveyance used, but the historian's words are as follows: "Toward the end of Charlemagne's reign, certain persons who lived near Mount Pilate, in Switzerland, knowing by what means pretended sorcerers traveled through the air, resolved to try the experiment, and compelled some poor people to ascend in an aerostat. This descended in the town of Lyons, where they were immediately hurried to prison, the mob desiring their death as sorcerers. The judges condemned them to be burned, but the Bishop Agabard suspended the execution and sent for them to his palace that he might question them." Our own history records that there were other helpless victims condemned to be burned on American soil who had no good Bishop to suspend the execution. Cultural Evolution is fast casting into the discard the deluded thoughts of mankind that have sacrificed so many thousands of their brothers upon the altar of ignorance.

But a new thought was born that had potential possibilities beyond the fondest hopes of any then living. Benjamin Franklin said of this new method of aerial navigation, "It is an infant, but it will grow." Balloon travel began in England in 1784. The first ascension on September 15 of that year drew out the greatest throng that had ever gathered on British soil. The brave sons of England, France

and America offered their lives, if need be, in studying the hidden secrets of air travel. As a practical, certain and safe means of air travel, the passive balloon was not a success; however, the motor driven dirigibles are, as yet, in their infancy, and we know not what the future will bring forth in the further development of this method of aerial navigation. Only twenty-five years ago many of the best informed in aerial navigation suggested that the possibilities of the balloon had been exhausted, but we know now that these possibilities are in the early stages of development.

A new thought was budded to the original ideas in the form of the internal combustion engine as a motive power and this has developed the greatest epoch of advancement in rapid transit that civilization has known. Because it came into being at so late a date, its evolution may be traced with a greater degree of certainty than that of any other mechanical force now in use. The internal combustion engine has revolutionized all methods of travel on and under the water, on land and in the air, and has done more to aid and advance individual and family travel than all other methods combined have done. It was not evolved out of some man's inner consciousness fully developed and ready for use as we now have it, but on the other hand, it has developed from crude applications, modifications and changes until it has reached its present form of near perfection. It is an end to which thousands of the greatest engineers have dedicated and consecrated their lives for the benefit of the succeeding generations or until such time as some other and more convenient force shall supplant its use.

Man's idea of constructing a device whereby he could propel himself on wheels not drawn by animals is a modern idea dating back a little more than one hundred years. Apparently the first step in this direction was an evoluted form of the child's play horse commonly known as the "hobby horse." The new device was known as the "Dandy horse." It consisted of two wooden wheels held in iron forks in a similar manner to that of the modern bicycle. These forks were fastened together by a bar of wood with handle bars on the front fork in order that it might be guided in the desired direction. A cushion or seat was placed on the middle of the bar upon which the rider sat. It was propelled by his feet pushing against the ground. It would coast down hill without any pushing. This idea was the ancestor of the bicycle and riding the "Dandy horse"—especially down hill—became a great fad in England about one hundred years ago and they were also in common use by postmen. It was an easy step in adding a crank, pedals and a sprocket wheel which made the bicycle. Bicycling became the craze of continental Europe, England and America. New records of speed were established only to be beaten again until the record time of the stagecoaches were beaten by about one-half. Thus, with a muscle propelled machine, man had transported his body over long distances at a greater rate of speed than had ever before been done except by the locomotive on steel rails.

A speed of forty-one miles an hour had been attained by the muscle driven bicycle, but human muscles become fatigued by long continued violent exercise. It had become a means of rapid transit by professional and business people

generally and inventive minds set about to perfecting a motor that would supply the propelling power. This was soon accomplished and the motorcycle came into being. With these greater speed was attained by the use of the blind forces of Nature which do not tire and which need only the directing force of trained intellect to guide them in their course.

Civilization had advanced to a point where necessity demanded a conveyance capable of traveling swiftly over the public highways and which was not limited to the costly locomotive and steel rails. The expense in constructing and operating railroads prohibited their use as a means of private conveyance and inventive genius was now directed to the development of a light and speedy conveyance that could be used for private purposes on the public highways. There were many steam driven carriages devised and operated on the public highways but because of the weight, smoke, noise and vibration of these vehicles, their use did not become general and as a whole they were not satisfactory and were soon cast into the discard. However, they formed a link in the chain of motor travel and many of their mechanical principles were passed on to the next generation of motor vehicles.

The next step in private motor conveyance was that of the automobile, which has done more, perhaps, to change the habits of mankind than any other conveyance yet devised. The history of the development of the internal combustion engine and the detail of its principles and mechanics are so extensive that many volumes have been

written in explanation thereof. Like all other mechanical devices that have become so universal in their use, it has passed through an evolutionary stage of development, adaptation, change and growth. It is sufficient here to state that its simple principle is an explosion within a cylinder containing a movable piston that is driven by the force of the explosion, thus producing the power that is conveyed in many ways. The application of this principle has done more to eliminate time and to shorten space in transportation than any other invention. Its power is applied alike on water, land and in the air. It has made man a migratory being and has extended his range of travel to uttermost limits of the world. It has made possible a change in the speed of land travel from the stagecoach's four miles per hour to the automobile's four miles per minute.

Man had learned by observing the birds that the swiftest medium of travel was through the air and he set about to devise a method of overcoming the force of gravity so that his body could be propelled through the air at a greater rate of speed than any yet attained. The development of the airplane has accomplished this end. With no rivers to cross, no roads to grade, no tunnels to dig and no bridges to build, the airplane now carries his body through the air at a greater rate of speed than any living creature has ever before traveled; and yet, air travel is still in its infancy and its future possibilities cannot now be foreseen by those most advanced in the science of air navigation. Now, better and safer designs are supplanting the old. Statistics show that air travel is now more than sixty per cent. safer than any

other method of travel and it is the prophecy of those best qualified to speak that within a short time its hazards will have been removed and its features of safety increased to approximate perfection.

CHAPTER VIII.

The Developing of Communication.

COMMUNICATION is the most necessary part of human society and without it organized human society could not exist. The earliest efforts at communication were, doubtless, outgrowths of the herd instinct. All animals have some form of communication which is not only understood by all members of the pack, herd or flock, but also by other species that are living under the same or similar surroundings. The danger signals of one are apparently understood by all. The snort of a deer denotes the scent of a common enemy. The warning call of the elephant silences all the animals of the jungle and informs them of the approach of danger. The sudden flight of the tick birds prepares the rhinoceros for instant battle. These are instinctive impulses that experience has taught must be obeyed as a matter of self preservation.

Man has inherited and still obeys the instinctive impulses of his primitive ancestors and it is only reasonable to suppose that before the development of articulate speech, and the power of reason, he followed the urge of instinctive protection as a means of self preservation. It is largely a matter of conjecture and speculation as to the warning signals used by man before articulate speech was developed, but basing our observation on the instinctive impulses of the lower animals and of man and examining the development

of the earliest known human skulls, evidence is both cumulative and persuasive that primitive man traveled in herds and was guided and directed by instinctive impulses much in the same manner as are the wild animals of today.

The emotions of both fear and anger will cause the hair of many of the animals to "stand on end" and this nervous reflex is accompanied by a warning growl. The purpose of this is, perhaps, to present the most hideous appearance to the approaching enemy and to warn it of the danger of an attack. Dogs will bare their teeth, raise their hair, stiffen their muscles and growl before beginning a fight. A bull will bellow, paw and horn the earth and stiffen his muscles before beginning an attack. These are animal means of communicating warnings of a purpose to overcome their enemies by means of force and with the natural weapons that they possess.

When articulate speech was in its infancy a single word was used to express an idea. Many of the first words coined, as we have already seen, were used to represent some imitative sound and articulate sounds were applied to represent certain objects or things and thus objects and things were recognized by certain names. The expression "bear" meant to primitive man "I see a bear" or "There is a bear." If his companions were not in a position to see the bear, then the one uttering the expression indicated the position or direction of the bear from the group by pointing his arm or finger in the direction of the bear. It was in this pantomine manner that signalling became a means of communicating ideas by primitive man. But there were times when natural objects obscured the vision of the group of

hunters so that the pointing signal was of no use or benefit and this led to the invention of sound signals that could be heard but not seen.

The signalling systems have reached a high degree of perfection among all primitive peoples. The natives in the jungles of Africa use a system of imitative calls for sound signals. These calls imitate the common calls of the birds found in the locality and their purpose is to deceive the hunted animals against their approach in case any unusual noise is made. Their reasoning is well founded for so long as the native birds are calling undisturbed, the animals that are the objects of their hunt will not be alarmed at any slight unusual sound. But there are times and conditions among the savage tribes when it is necessary as a means of self protection to have a system of sound communication that will outreach the human voice and this has given rise to the practice of drum signalling. Sound signals by the use of drums are employed as a means of communicating from village to village in case of war and as warning against the approach of an enemy. This is a code signal which is understood by all those members of the tribes who hear it and nothing will cause greater consternation and quicker action among the savage tribes than the warning signal of the drums.

Another method of signalling among the savage tribes by night is the building of fires at strategic points on the hilltops that may be seen by some distant village and it in turn will build another fire that may be seen by the next village and this predetermined method of communication may, and often does, extend over vast areas in a single

night, thus serving as a means of communicating the message it is intended to convey. The sign language formerly in such common use among the western tribes of Indians and the sign languages of the deaf mutes are examples of the effectiveness of these methods of communication.

From the beginning of civilization to the present time the use of signals as a means of communication has been employed by the most highly cultured as well as by the lowest savage tribes. In the early days when life and death were at stake, the necessity for speedy communication was just as great as it is with our complex system of civilization and called forth the greatest effort in its attainment. As early as 260 B. C. there is a record of a completely developed signal corps which is found in the writings of Polybius. This was a method of signalling by night with torches and was an evoluted form of the hilltop fires. This system with certain modifications and additions was still in use in parts of continental Europe as late as 1684. The first practical system of successful long distance signalling was established between Paris and Lille by the French Government, a distance of 150 miles. This consisted of a series of stations arranged at convenient points so that each station erected was in view of the next succeding station. Each station consisted of a pole, a beam, movable arm and ropes and 192 different signals which were arranged on the movable arm as the contents of the message required. Skilled operators who had been trained in the method of placing the signals were stationed at each pole and with the aid of the telescope, messages could be sent with considerable dispatch. The first message sent over this line was one

announcing a military victory in 1794. The message was sent from Lille to Paris, where the Chamber acknowledged the services of the army to the country and this message was sent to the commander and his acknowledgment of the message returned and received on the same day. Thus messages conveying definite human thought had been communicated over this signalling system for a distance of 450 miles in a single day. The success of this achievement led to the establishment of many other similar lines throughout the country.

The distance between the stations varied with the topography of the country, but the usual distance was five to six miles and the operators became so expert in the handling of these signals that a message could be sent for a distance of 150 miles in three minutes. Other countries took up the system of communication by signalling and established similar lines. At first these lines were used for military message, but like the first passengers on the railroad, the people began to request their use for commercial purposes. This led to the placing of an additional movable arm on the pole and one arm was used by the government for military and other public messages, while the other was used, for hire, by private individuals for commercial and other uses. The cross-arms and the additional wires of the modern telegraph pole is an evoluted idea of the extra arm for commercial purposes established on the poles of the signalling systems.

This system was a great advancement over the earlier systems of signalling, but it failed to meet the demands at all times of the ever-increasing desire for speedy communication. On a clear day it was a success, but at night and

during rains, snows and fogs it was useless. Some of the signalling lines established in England were idle for periods of as much as nine months each year because of excessive fogs. Any system that had to yield to the changing conditions of the elements must of necessity be cast into the discard as soon as better methods were evolved; but like the stagecoach, it served its purpose in its day.

Man's inventive genius has thus far been able to meet the demands of the changing conditions of our civilization by devising mechanical agencies, aided by the laws of Nature, that will produce the desired results. Since speedy communication is the most important factor in organized society, and since Cultural Evolution had advanced to a state wherein necessity demanded a better system than was then in use, Nature gave up another secret in the form of electro-telegraphy that eliminated both time and space so far as practical human calculations are concerned and made approximately instant communication possible.

The ancients knew something of the force of frictional electricity as early as 600 B. C. They did not understand this force and neither do we after nearly 3,000 years of experimenting with it. Amber is the fossil resin of a pine tree and is found on the shores of the Mediterranean sea and elsewhere in Southern Europe. It was a semi-precious stone among the ancients as it is now with us. When this stone was rubbed against some other objects, it became magnetized and had the power of attracting lighter bodies to it. Thales of Miletus, the father of Greek philosophy, explained this mysterious effect by ascribing to it a "soul" and he let it go at that; but as the centuries rolled on, men

of inquiring minds began to study this unknown force, and little by little human intelligence began to uncover some of its habits. By the time this force was called upon to become a means of communicating thought, it had been discovered that it had a speed sufficient to travel several times around the earth in a single second and that it would follow a certain path in the form of a conductor if the human mind would first prepare and direct the way, and that many objects besides amber would attract lighter bodies when rubbed, thus generating frictional electricity.

Like the acorn in its hull that contains all the potential possibilities of the giant oak, so the force of electricity at this period of Cultural Evolution contained all the potential possibilities that were to revolutionize the industries of man and play so great a part in his habits and customs and in his manner of living. He set about to direct and control this force and to make it obedient to his will and this procedure was one of many trials and experiments, of discarding the useless and keeping the useful, of adaptation, change, modification, development and growth, until the combined ideas of the searchers had discovered a method of control suited to his use. In this respect as well as in all others, Cultural Evolution was following the lessons taught by Organic Evolution that nothing comes by chance, but that there must be adaptation, change and growth.

The problem that was now presented was the devising of a system of signals that could be understood and interpreted by both the sender and the receiver. Many crude but ingenius devices were conceived and put into limited use for sending messages over wires, but the credit belongs to

Professor Samuel F. D. Morse, of New York, for inventing the telegraph system in 1837, which has since been modified and is now in such common use throughout the world. The original Morse relay weighed 300 pounds, while that employed today weighs about three pounds. The Morse code is a system comprising an arbitrary alphabet and consisting of the dot, the dash, the ordinary space, the letter space, the word space and the sentence space. The duplex system, the sending of two messages at the same time in opposite directions, was perfected by J. B. Stearns in 1872 and the next year Thomas A. Edison perfected a method of sending two messages simultaneously in the same direction over the same wire. This was quickly followed by the quadruples and multiplex systems. This method of instant communication has extended to the stock quotation tickers, the typewriting and autograph telegraph as well as photography by electrical transmission. These lines of communication have been extended to all parts of the civilized world and the necessity for speedy communication between the continents has been solved by the submarine cables that bind them together for this purpose.

The telegraph, like the railroads, necessitated a system consisting of a line of poles, means for producing the electric current, means for conducting the electric current, means for controlling the duration of the current, and other factors as well as an understanding of the system and its code. While this was a great public necessity and while its service could be employed for hire by a private individual, yet the complex system of modern civilization demanded a system less complex in its nature and more practical in its use.

The telegraph was a conveyor of signals but civilization demanded a conveyor of the human voice and one that could be put to more general and practical uses in the every day affairs of life. This necessity gave rise to the invention of the telephone, an instrument for the transmission and reproduction of articulate speech between two or more distant points.

The telephone was a lineal descendant and a direct offspring of the telegraph that had preceded its coming. All the thoughts that had been conceived and applied in making up the telegraph system were commingled and all the useful parts were retained and the useless discarded and with the addition of new ideas, the telephone was developed. The fact that sound could be transmitted over tightly drawn wires had been discovered as early as 1667, but the first practical demonstration in transmitting sound by artificial means was through a tube and by the use of the string telephone. Like that of the telegraph, many impractical devices came into limited use, but it remained for Dr. Alexander Bell, of Boston, to perfect the first practical instrument for conveying the articulate human voice to distant points. He made application for a patent on his new invention on February 14, 1876, and, strange as it may seem, Professor Elisha Gray made application on the same day for a patent on a similar instrument. Extensive litigation was then entered into between these two claimants, which was finally decided by a decision of the Supreme Court sustaining the claims of Dr. Bell.

The first idea was that the telephone should be for private use connecting the home of one person to that of some

friend or relative, but its usefulness was at once so clearly recognized that the next year G. G. Hubbard conceived and devised the switchboard, making it possible for the owner of a telephone to connect with all other telephones in the neighborhood. This idea has been extended until it is now possible to reach many millions of telephones from a single point. The idea of a long distance telephone was an afterthought and it was several years before this idea took on form and came into being.

Newspapers are the most potent factors in spreading written thought that civilization has known. They vie with each other for every morsel of news that may be of interest to their readers. They furnish a record of the passing events of the entire world with a swiftness undreamed of a few generations ago, and yet the first newspaper report ever received by wire was within the memory of those still living. They were the first agencies to seize the opportunity afforded by the telegraph and telephone and to make use of them as aids in conducting their business. It is difficult for those now living in this age of electricity to understand the sluggish methods employed by the newspapers and the patience of their readers before its use as an agency of dispatch began, but we are three generations advanced and each generation leaves a heritage which the preceding generation did not have and, doubtless, three generations hence our descendants will look upon our sluggish ways with the same lack of understanding as we do theirs.

All the systems thus far advanced in the electro telegraph and telephone required the aid of metallic conductors over which the messages could be carried. These necessi-

tated the erection of costly lines which at best could reach only a portion of the population of the earth and because of physical barriers some portions of the earth could not be reached at all. Millions of people had no access to either telegraph or telephone lines, but experiments with the telegraph and telephone had revealed the fact that there were many hidden secrets yet to be discovered in connection with the electrical method of transmitting sound. The searchers were not satisfied and they continued in their work.

Professor Morse, who perfected the telegraph, was one of these searchers, and in 1842 he made experiments that proved that electric telegraphy could be had between stations not connected by wire, but for what distance he did not know. It had been discovered as early as 1838 that the ground could be used as a conductor in completing the circuit in ordinary wire telegraphy. Hundreds of patient toilers continued to experiment and traded to each other the results of their observations, but it remained for Guglielmo Marconi, an Italian, to perfect the first device for sending signals based on the radiation and reception of grounded or guided electromagnetic waves. This was in the year 1896, and it was a combination of all that had been learned in this connection together with the addition of new ideas put into use.

At first messages were sent for comparatively short distances and the Morse code was used. Like all other discoveries, the basic idea was improved upon, obstacles were overcome and new ideas added. Only seven years after this new invention came out, or in 1903, a message was transmitted across the Atlantic Ocean, a distance of 2,300 miles,

from President Roosevelt to King Edward VII of England and a new era was ushered in upon the stage of human action in the science of communication. If we shall suppose that we are on a vessel in the middle of the ocean and that the vessel is disabled and sinking or is on fire; that an S O S call is sent out and an answer is received that aid is coming, or perhaps we have taken to the lifeboats after the assurance of aid is received, then and only then, can we fully appreciate what wireless telegraphy means to civilization. Before the development of this thought, many thousands of persons whose lives to them were as valued as ours are to us, were lost in the depths of the ocean without a trace.

But again the greedy searchers were not satisfied and they continued to work. They reasoned among themselves that since it is possible that signals may be carried on the radiation and reception of guided electro-magnetic waves, and since the signals represent sounds which are an arbitrary alphabet, why is it not possible to carry the articulate sounds of the human voice in the same or a similar manner?

The next link to be added to the chain of progress in the science of electrical communication was that of the radio, the most mysterious and far-reaching means of communication known to civilization. It is of such recent origin that no description of its parts is here necessary. Its hidden secret was found in a vacuum tube and like so many of Nature's secrets, this was discovered largely by chance. It is one of the greatest means of education ever devised. Scientists tell us that not a word we speak is lost and that every audible sound is carried on the wings of the ether waves to the uttermost parts of the earth. They may go,

for aught we know, flashing through space to the most distant star. It matters not how far you are removed from civilization, for with the radio, the voices of speakers and the delightful strains of music are brought to you wherever you are. You may be flying through the air in a radio equipped plane, or in the middle of the ocean, or in your car or in the vastness of the mountains and you can hear the same voices and the strains of music that are being heard by millions of people—old and young, rich and poor, tradesmen and artist, great and humble throughout the world. The soothing lullabies that our grandmothers sang to our fathers and mothers in tender childhood are again brought to us in the nightly old-time programs. The old-time hymns that they loved so well and that were incarnated in their spirits are, by the radio, being reincarnated in us. All that is holy, sacred and good is again being brought to us without any effort on our part except to listen. "What a comfort is this heritage for the ages," to the sick and afflicted and to the "shut-ins!"

The story of the mythical Orpheus with his entrancing lyre is dwarfed by the realities of fact. Like the development of all forms of plant and animal life that have developed from the lower order to the higher under the direction and guidance of the Universal Plan, so these methods of communication have been developed from the primitive ways of our primitive ancestors through the agency of the human mind by the evolutionary process of change, modification and growth.

CHAPTER IX.

The Developing of Power.

PHYSICAL power is the moving force of the world and it represents the work done by a machine or any agency in accomplishing any change which requires work. Until man began to use the force of the muscular strength of animals and the forces of nature to aid in accomplishing his work, all the utilized power was that of human muscular force. Primitive man had lived through many thousands of years before he began to utilize the muscular force of animals to aid him, and even then, he passed through many more thousands of years before he began to utilize the forces of nature. We have seen that he utilized the force of the instantly released tension of his bow to furnish the propelling power that drove his arrow and that he used a stone propelled by the muscles of his arm with which to crack nuts or crush the bones of some animal he had killed. These were, doubtless, the first agencies used by primitive man aside from his own muscular forces.

Early in the history of our civilization primitive man made use of the force of gravity in floating down the streams on a raft or in a crude canoe and he also made use of the force of the wind by attaching sails to his rafts or boats. Aside from satisfying his hunger and protecting himself against the cold and his enemies, his wants were few, but even before written history began he had discovered

methods of moving huge stones, the movement of which would baffle the greatest engineering skill of today and put to the severest tests the heaviest machinery used in our modern civilization.

As the relations of human society became more complex, there came a demand for more power than human and animal muscles could produce. Man began to study and to apply the forces of nature to aid him in his work. He made use of the force of gravity by applying the power of falling water to the wheels of his mill. One device would produce the necessity for another. A new thought that contained the possibilities of usefulness would be passed on to many searchers and by the application of many minds, obstacles would be overcome and the thought developed into concrete and useful form. As knowledge increased, useful and helpful devices were multiplied in numbers until Cultural Evolution had advanced to the beginning of the Machine Age.

The beginning of the Machine Age is usually ascribed to the invention of the steam engine in 1769. It is well to pause here for a moment to see just what had taken place in the development of steam power before Mr. Watt, as he walked across a golf course, conceived the idea that made its use practical. Like the signalling system, the telegraph, telephone, radio and all other useful devices, the use of the power of steam traveled the evolutionary path in its development. Searchers of Italy, Spain, France, England and other countries were seeking a means to control and utilize the power of steam. It is reported that a Spaniard by the name of Blasco de Garay in 1543 invented and made use of a steamboat in the harbor of Barcelona, Spain, and in 1629

an Italian invented a device which was in the nature of a steam windmill, the steam being generated in a boiler and then forced through a tube against the flat blades of a wheel, which set the wheel in motion. The idea of the piston was conceived by a Frenchman. The early principle of the steam engine was by throwing a jet of cold water into the cylinder to condense the steam. This caused a vacuum below the piston, which was forced down by atmospheric pressure. The steam cock was then turned to admit fresh steam below the piston, which was raised again. The opening and shutting of the cocks was performed by hand, then by a system of strings and valves and then by a system of hand gear. By these crude methods, about three-fourths of the steam admitted into the cylinder was lost and its power wasted. At this stage of the development of steam power it was in about the same state of progress as was the signalling system used in France when the pole, beam and movable arm were in use as a means of communication.

The idea which Mr. Watt applied to all the ideas then in use for the control and use of steam as a power was the providing of a separate vessel in which to condense the steam and which could be constantly kept in a state of vacuum without any loss. This simple principle of physics made the use of steam the greatest agency for power the world has ever known. The use of steam as a power has done more to develop the industries of the world than have all other agencies combined. Its far-reaching effect on the advancement of civilization was, at the time of its origin, beyond the power of human comprehension. It will suffice to say that, whereas, the time was when all the utilized

power of the world was derived from muscular force, now more than ninety-two per cent. of the utilized power of the world is obtained by artificial means.

When the power of steam began to supplant the power of muscular force, the necessity arose for a method of measuring this new power. It was at first measured in units of human muscular strength, the power of ten men being equal to that of one horse. The system of measuring power was then changed and the force that could be exerted by a heavy horse during a given period of time was then adopted as a standard of measurement and since that time the power of all steam boilers has been measured in horsepower. A horsepower, therefore, means the strength or force required to lift an object weighing 330 pounds to a height of 100 feet in one minute, or 33,000 pounds one foot in one minute. As an illustration of the increase in concentrated mechanical power the mind of man has conceived and his hands constructed a single machine in the form of a steam turbine that furnished power equal to that of 2,000,000 men.

After a method for the practical control of the power of steam was discovered, the next problem that had to be solved was a method of transmitting the power generated by the parent motor to the machines that were to do the work. In nearly all cases where steam is used for power, it is necessary to transmit this power for considerable distances to the machines which are employed to do the required work. Many methods have been devised in accomplishing the transmission of power and these methods are classed as gears or gearing, belts, chains, ropes, compressed air, hydraulic pressure, and electricity. For short distances,

gearing is the oldest, the most extensively used and the most efficient method employed in transmitting power. This is accomplished by wheels containing teeth or cogs fitted on shafts so that the cogs of one will fit between the cogs of the other and they drive each other by pressure on the face of the cogs. The speeds of rotation are governed by the size of the wheels.

Next to gear transmission, the method in most common use and the one used for longer distances is that of endless belts fitted on pulleys, where the power is transmitted to the driven shaft by means of friction or adhesion between the surface of the belt and the surface of the two pulleys. The power of rope drives is accomplished in the same manner while that of the chain drives is nothing more than gearing by remote control. Compressed air is extensively used for transmitting power where it is necessary to move the power from place to place, such as in mining operations and also where it is necessary to apply the power instantly.

The discovery of a method of utilizing the power of steam opened up vast avenues of other methods of producing power that are useful to mankind. It was discovered before the coming of the steam engine that electricity could be generated by friction, but power was required to furnish the friction that would generate the electricity and steam was the first agency to furnish this power.

Another means of deriving power from a natural source is that of the windmill, which is a motor that utilizes the energy of the wind for developing power sufficient to do light work. It is used more especially on farms where irregular power is sufficient to meet the necessary require-

ments, but it is dependent on the uncertain elements for its force and until recent years its chief purpose was that of pumping water which could be stored in sufficient quantities to last until the wind was of sufficient velocity to pump again. But within very recent years methods have been devised whereby the force of the wind has been transmitted to storage batteries, where its power can be utilized during periods of calm and the battery is constantly recharged when the wind again blows. With this inexpensive method of operation, many farm houses, far removed from any electric power line, now have the advantages of electric lights and other electrical conveniences by utilizing the natural air currents.

When the steam engine became of general use and its economic power had been proved, old methods that had been in use throughout the centuries began to give way to the new. Boards could now be made with the sawmill instead of the whipsaw and the broad ax; the thrashing machine supplanted the barn floor, the ground and the hand flail as a means of separating the grain; the spinning wheel and the handloom surrendered to the automatic shuttle; water navigation no longer depended on the current of the stream or sails with which to catch the wind; the pick and shovel were supplanted by the steam shovel; the striking power of the hammer was increased many thousands of times; grain could now be ground without the use of the water wheel and so on through out all industrial activities. The steam turbine was late in its coming, but it represents the greatest power to which the use of steam has been applied. In a sense it is the principle of the water wheel

propelled by steam pressure on the blades or paddles instead of water.

Waterpower, or power produced by the force of gravity in falling water, is the cheapest power yet known. Unknown millions of horsepower in falling water are wasted each day, and as yet it is only utilized in a small way. Its force is being converted into power that can be transmitted over long distances in the form of electrical currents and applied to the uses of man in the form of light, heat and power. The time is rapidly approaching when the power of falling water will no longer be wasted, but will be further utilized for the advancement of human progress.

It has been seen that electrical energy can be generated by artificial means and the electric current is generated by dynamos driven by steam, gas, wind or waterpower. The power for commercial uses is generated at a central plant from which point it is transmitted over wires to the places where it is consumed. The developments of high-voltage power transmission have made it possible to convey electric currents for great distances, and the development of the steam engine has made it possible for the development of electrical power wherever fuel and water may be had. It may be said that the development of controlled electrical power had its origin in steam, but electrical power is now fast supplanting the power of steam for commercial uses. These two agencies have been the means of developing the industries of the world to their present state of development and of changing the habits and customs and the manner of living of a large number of the human family, for wherever the steam engine and electricity are not found, people are

living in much the same way that they did 200 years ago. The power produced by steam and electricity have called into being a billion mechanical forces now aiding the work that our complex system of civilization finds necessary to be performed.

We have seen that power can seldom be used in the exact place where it is produced, but that it must be transmitted to machines that do the work for which they are designed and this, as we have seen, necessitates wheels, shafts and bearings. For heavy work, these wheels, shafts and bearings are made of steel and many of them rotate at high velocities. These bearings rotate against each other as steel on steel. They may be polished as smooth as glass, but if they are examined under a magnifying glass, it will be observed that their surface contains pits and protuberances somewhat like the shell of an egg. These bearings working against each other produce friction that develops heat. This must be overcome by a film of oil floating between the bearings at all times and if this film of oil is taken away from the bearings of the wheels of industry for a single day, the world's progress will stop. Animal and vegetable oils were used at first to lubricate the wheels of industry, but as industries grew and bearings increased, there was not sufficient animal and vegetable oils for this purpose, so again civilization demanded that a substitute be found. The genius of man supplied this requirement by discovering and utilizing petroleum or oil that was hidden in the rocks beneath the surface of the earth, and thus another industry sprang into being that was destined to play a greater part in

the advancement of civilization and the development of industry than any other has ever done.

The discovery of crude oil or petroleum, like so many other useful discoveries that have aided so greatly in the progress of our civilization, was accidental. Oil seepages or springs had been known since early Bible days. In western Pennsylvania oil springs had been discovered by the early French explorers. The oil from these springs had been used by the Seneca Indians before the Revolutionary War. After the establishment of the United States Government, great hordes of people from the Eastern States began their western march seeking new homes in the more fertile regions of the unsettled West. Their only means of travel was in covered wagons and on flat boats that floated down the rivers. They carried all their earthly possessions with them. The forests abounded with game and the rivers with fish and the virgin soil yielded abundant crops, but there was one necessity that they did not have and that was salt. Salt springs were extremely scarce and these would not supply the demand for salt. Shafts that were dug by hand developed the fact that the salt water that was supplying the salt springs was coming through crevices in the sold rock. This led to the devising of tools and to the drilling into the rock seeking salt water from which salt could be made. It was through this process that crude oil and natural gas were discovered in their secret hiding places.

The first oil well that was drilled for the express purpose of searching for oil was completed in 1859 in western Pennsylvania at a depth of fifty-nine and one-half feet. It was not then and neither is it now given to man to know

the far-reaching effect this discovery was to have on the advancement and progress of the civilization of the human race. Before the discovery and use of crude oil came into being the entire world was in darkness except for the light furnished by the tallow candle and the lamps that burned animal and vegetable oils. The resources of the country were being rapidly developed. Steam driven, labor-saving machinery was being developed more rapidly than at any time in the history of civilization. Industries were springing up in every part of the settled country. Rail and water transportation furnished a method of transporting products to market. Roads were being constructed and cities and towns were being built. Light and lubrication were the greatest needs of civilization and crude oil now furnished a means of supplying artificial light and of lubricating the wheels of industry.

Petroleum, or rock oil, is composed chiefly of hydrocarbons, and together with natural gas and asphalt it is classed as a bitumen, the oil forming the liquids, the gas the vapors and the asphalt the solid parts. Oil and gas are so closely related that what is said of one practically applies to the other, because liquids may be made from gas and gas may be made from oil. Its discovery in quantities was looked upon as the agency that would furnish light to the darkened world and lubrication to the wheels of progress, but its vast potential powers were undreamed of in the beginning of the oil and gas industry. No other resource had done so much to change the habits and customs of the human family and to lift so many burdens from mankind in his struggle for existence and mastery as this has done and

yet the industry is in its infancy. The magnitude to which this industry has grown in so short a time is the most stupendous fact in industrial progress.

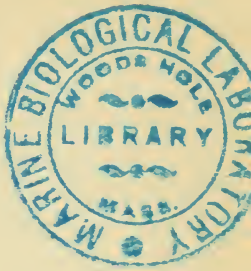
Its hidden powers were discovered from time to time as the industry developed, but not without the costly sacrifice of thousands of human lives. New uses were found to which it could be applied as an agency for advancement and each new use discovered developed many other collateral uses. In many cases these secondary uses developed the by-products into the principal products.

In discussing the power of steam, no mention has been made of the energy and compounds which are required to produce the steam—namely, heat and water. Before the discovery of crude oil and natural gas, the heat that produced steam was formed by the combustion of wood or coal, but wood must be cut and coal dug from the ground. Natural gas is the only perfect fuel known to man and the only product that possesses the quality of transporting itself by its own force to the places where it is consumed. It not only became an agency of light, but also an agency of heat in the regions wherever it was found, and it soon became the fuel in general use in these regions. But the searchers discovered that when it was mixed with air in certain proportions it would explode and that by causing it to explode in a cylinder containing a piston, it would produce power and thus was developed the internal combustion engine. But natural gas being a vapor cannot be carried in an open receptacle, but it must be contained and conducted in air-tight pipes or other receptacles. The searchers discovered that the more volatile parts of crude oil may be changed to

vapors and again to liquids that will vaporize and furnish an explosive gas the same as natural gas will do. This product we call gasoline. It was learned that gasoline may be transported in barrels or tanks and in many other ways to regions far removed from any gas line and there used in the cylinders of internal combustion engines and thus the automobile and other gas propelled conveyances came into being. The searchers also discovered that natural gas is composed of a series of gases and that some of these may be reduced to a liquid that will instantly vaporize upon being exposed to the air and that this liquid may be carried in containers to all parts of the world and there used. The common name of this liquid is butane and it is now coming into common use in regions far removed from the place of its origin.

A hundred other similar uses might be mentioned, but these are sufficient to show that industry develops with the development of human thought and like the growth in organic life, development is a slow changing process. No one knows what future devices may yet be developed to which the explosive power of the hydrocarbon particles of crude oil and natural gas may be applied, but within the memory of those still living, it has wrought the greatest change of any natural resource ever known. In its brief period of time it has changed the habits and customs and manner of living of the entire civilized world and has done more in transportation to eliminate time and to shorten space than any other natural resource has done. It has changed darkness into light for multiplied millions throughout the civilized world. It is lubricating the bearings of

millions of machines with its film of oil without which their wheels would not turn for a single day. As a fuel, it is both instant, regular and automatic. It has largely driven the horses from the streets and roads and unhitched them from the plow. It propels man's body over the roads and through the air at a faster rate of speed than any living creature has ever before traveled. It furnishes the power for lifting, dragging and pulling the loads that once were done by muscular force. Competent engineers tell us that there are known sufficient reserves to last for hundreds of years. It is more valuable than all the gold, silver and diamonds in the world. In our modern and complex civilization, it is as indispensable as the sunshine. It is liquefied sunshine stored away millions of years ago to be used by mankind when Cultural Evolution under the Universal Plan had prepared him for its use. When it shall have been exhausted, doubtless, then Cultural Evolution will have devised methods of extracting from the sun's rays or their products sufficient power to supplant the needs of the generations then living.



CHAPTER X.

The Developing of Art.

WE have thus far seen that since Cultural Evolution began, nothing has changed but human thought. The Searchers have been studying and classifying the forms, structures, composition, laws and uses of the natural objects and the forces of Nature and their relation to each other and they find that Nature is the expression of the Divine Plan of Creation for nothing in all the world has come by chance. But as primitive man began to understand and to reason from cause to effect, he began to see beauty and harmony in all things around him and to construct and put together the things about him which Nature had prepared in order that they might better serve him in a useful way and add to his comfort and happiness.

The knowledge which man has acquired about Nature is called "Science" while the work he has done in changing the forms of Nature is called "Art." He can neither create nor add to matter but he can change its forms. Art is therefore the expression of the human mind in changing natural objects and forces so as to better fit them to his use. After he had left the trees and had come down to occupy the caverns of the earth, his Art began to manifest itself in carvings on cavern walls and on bone and ivory and also in drawings and pictures of the chase. When he chipped a

piece of flint into a cutting instrument or fashioned it into a spear head, or struck from it a spark of fire, this was Art. It was the changing of the forms of matter which Nature had prepared into different forms more suited to his use. We thus see that all created matter and the changes wrought therein by man embrace the whole of Science and of Art. But as Science, the knowledge of natural things, is divided into many parts so also is Art divided into many classes.

The principal divisions of the work that man has done may be properly divided into two general classes: *viz.,* The Useful Arts and The Fine Arts. The man who makes a shovel, a plow, a horseshoe or who builds a house is just as much an artist as the one who paints a picture or chisels a piece of marble into an image of life. The Useful Arts have become so commonplace that we seldom ascribe to them the name of Art, yet many of the Grecian philosophers, and Plato in particular, placed them on a higher pedestal in Cultural Evolution than they did the Fine Arts because of their usefulness to mankind.

The Fine Arts are expressions of the human soul. They are the efforts of man to re-create by his own hands the beauties of Nature. From the flowers and verdure of the countryside, the painter gets his inspiration of color schemes, the snowflake gives to the architect and builder its angles and designs, the rhythms of Nature and the songs of the birds inspire the desire to reproduce them by human effort. The material arts—Architecture, Sculpture and Painting express the harmony, beauty and design of the

things that man sees about him while the deeper emotions are expressed in Music, Poetry and the Drama which transcend the material forms and carry our souls away for a glimpse into the realms of the Infinite.

The spark of genius that enters into the inner consciousness of some persons and that gives to them the power to re-create the things of Nature can not be explained by any of the laws of psychology but they are mental processes in tune with the Creative Mind which can not as yet be explained. The spark of inspiration that gave to them being may have been generated in a vision appearing to some remote ancestor that set in motion the electronic forces of the brain cells that continued to work through succeeding generations until the plan was perfected and its expression manifested in the genius of the Artist. It is through these re-creations that man's soul is lifted up until a glimpse of the perfect harmony of the Infinite may be seen.

We are all creatures of our environments and those living in one particular part of the world differ from those living in another part of the world. There are differences in races, food, clothing, shelter, language, habits and customs. These differences create different thoughts and different emotions and create different ideas of beauty. They find expression in race feeling, environmental emotions and racial standards of beauty and design. Because of these differences, we find the arts of one country or one people differing from the arts of another country or people. Some excel in one line while others excel in another. Again no two people see an object from the same intellectual angle. Like "The

Twelve Blind Men of Hindustan" they all see an object from a different viewpoint. A train carrying many passengers passes through a forest through which runs a beautiful stream beside which are shaded grassy places. The lumberman at once sees the wonderful lumber that could be cut from the giant trees of the forest, the cattleman sees the pasture possibilities of the hillside, the engineer sees the possibilities of the water-power the stream will produce, the sportsman sees a place that is a paradise for the trout fisherman, the geologist sees the earth's history written in the rock cliffs, the botanist sees the beautiful wild flowers, the naturalist sees a rare species of bird that is found in only a few places in the world, and the landscape artist sees the setting for a beautiful picture. They all see the same objects but from a different mental viewpoint.

We have seen that man disputed the right to the possession of the caverns of the earth with the gigantic cave bear until the power of mind overcame the power of brute force and left man in complete mastery of the caverns as a place of shelter and habitation. But the time came when the natural caverns of the earth were not sufficient in size or numbers to furnish a shelter for the increasing numbers of the tribes. This led to the necessity of making artificial caves as a place for both shelter against the cold and storms and as a place for his habitation. He then began building huts crudely constructed from sticks or logs and covered with brush and grass as a place of shelter. He then learned that the dried skins of animals made a better and more substantial covering for his hut than did the brush and grass

that he had been using, and finally the idea came to him that by placing flat stones upon each other he could construct a wall that was more durable than any shelter he had yet made. As yet he had no idea of beauty or design. His only thought was that of a shelter, but by slow degrees he began to conceive the idea of beauty and form in erecting structures. It was in this manner of evolutionary development that the Art of Architecture had its beginning.

As man progressed in the art of building the environment under which he had been living began to express itself in the buildings he constructed. They became more than mere shelters and the racial characteristics of the builders were woven into forms of beauty and design that were pleasing.

In no other art is this environmental expression more pronounced. In Chaldea, Babylon, Assyria and Egypt and in fact in all the ancient kingdoms and empires the soul of the people is expressed in its architecture. In Egypt we find expression for man's dream for immortality in the Pyramids, the Obelisks and the Sphinx. They reveal to us the Egyptian's belief in the immortality of the soul and that of his physical body as well. The ancient Egyptian rulers were looking after the welfare of their own souls and bodies with little or no thought of the welfare of the souls of the millions who slaved in the hot sun for unknown generations to prepare a place for the repose of the soul of their ruler. The wealthy people had their bodies embalmed and wrapped in costly linens while the bodies of the poorer classes were pickled in brine. Herodotus tells us that it

required the labor of 100,000 men for a period of ten years to construct a road from the Arabian stone quarries over which the stones were dragged or rolled that were used in building the Pyramid that was to shelter the soul of the cruel King Cheops.

The Hanging Gardens of Babylon, King Solomon's Temple, King Sargon's Palace, the Palace of the Persian King Darius etc., are examples of the vanity of the early rulers of Western Asia. Millions of men were worked under the lash like dumb animals to satisfy the vanity of those who ruled by divine right. The ancient architecture of these massive buildings had reached a degree of perfection that, perhaps, is unsurpassed today with all the heritage that has come to us through the centuries of the past. It is recorded that in one of these the reward that the master architect received was that his eyes were punched out in order that he might never again erect another so beautiful and pleasing.

Before written history began, the art of building had reached a high state of advancement and in no place in all the world had it reached a higher degree of perfection than it had on the island of Crete. The Cretan kings flourished for a period of about 1600 years, beginning, so far as our knowledge goes, about 5,000 years ago. They were the first to use a system of plumbing in their castles and used fine cut stones and brick for building materials. At that early day, they made use of highly colored porcelain tiles and crystal panels. The vastness of these Cretan palaces stagger our imagination in these modern times. The walls

of some of them were fifty-seven feet thick and like a great modern hotel there were quarters for many hundreds of persons. They were constructed to embrace the purposes of a state capitol, a hotel and a penitentiary combined in a single building. Their supporting columns were made of wood instead of stone but it was from these great palaces that the ancient Greeks borrowed many of their ideas that have made Grecian architecture so popular throughout the world.

Ancient Greece, as we now call it, was made up of a number of independent tribes or states in much the same manner as are the North American Indians. As the various tribes of Indians constitute a race, so the Hellenese forming the various Greek tribes or states constituted a people of the same blood. Many, many generations before the dawn of written history they probably sprang from the same race ancestry as did the Persians, but their environments changed their ways of doing and thinking, and as a consequence, they have had a greater influence on the advancement of civilization. Our records of their activities date back to about 1100 B. C. but at that time they had the heritage of the preceding generations of men to draw upon. They were quick to seize the imperfect alphabet of the Phœnicians and to improve upon it and they were also quick to seize the ideas that had been developed in architecture during the preceding centuries by the Cretans and others and to improve upon it also. They had a marked fascination for columns in their structures and of these they developed three distinct classes, *viz.,* Doric, Ionic and Corinthian, after which designs all their buildings are named.

Here, as in the case of Organic Evolution, the environment of the builders leave its mark and influence that is passed on to the succeeding generations throughout the centuries. The Doric column was developed by the Athenians. The Ionians who lived on the Aegean Islands and along the coast of western Asia developed the Ionic type and the Corinthian type is largely a combination of the other two. They put forth their best effort in erecting temples to their mythical gods such as Apollo, Neptune, Diana, Minerva, etc. In addition to the temples their principal public buildings were the theaters, all of which were "open air" constructions, some having a seating capacity of 50,000, the market places, or public square where public meetings were held, mausoleums and statues. What belonged to the state belonged to the individual and the spirit of personal greed had not as yet enmeshed the private citizen, and as a consequence the shade of a fig tree was an acceptable place for the discussion of the philosophies of life by some of the greatest philosophers who ever lived.

Greek architecture has become classic. It introduced proportion and depth. Flat surfaces were broken by curves and beauty of outline was its predominating characteristic. Like the styles in dress Greek designs will appear as the leading pattern and then change to some other form only to reappear at a later date. It has played a great part in the world's buildings and it will, perhaps, never be cast into the discard.

The Etruscans, or the people who inhabited Italy before the Romans came, carried with them the ideas of the archi-

tecture of western Asia from where they are supposed to have come at least 1,200 years before the Christian Era began. Their temples, palaces, pyramids, mounds and tombs were largely built of brick, which now form only ruins but enough remain to show us something of their race spirit. They doubtless came from the same ancestral stock as the Egyptians. Their tombs bear evidence that they were constructed as a resting place for the soul.

Roman architecture, which was copied largely from the Greeks, passed through the same evolutionary changes as their alphabet, with many additions, modifications, adaptations and changes. It became a style expressing the spirit or the soul of the Roman people. Unlike the Etruscans, they used more enduring substances in their buildings. They discovered that by mixing a volcanic earth with lime, a natural concrete was obtained and this substance played an important part in developing their art. Their buildings, like those of the Greeks, were made of enduring stone and marble and many of their arches were made from the newly discovered natural concrete, or pozzolana as it was called. Their buildings were distinguished by their decorations. The architecture of the world, represents a composite portrayal of the peoples of all races, over a period of centuries and expresses the feelings of the mass mind in the locality where the buildings were constructed.

The arts of sculpture and painting may be traced likewise back to their beginning 50,000 years ago. Within the caverns of France and Spain are found crude images of stone and drawings, carved or scratched with a sharp piece of

flint upon the smooth surfaces of the rock walls. Others are found carved on bone and ivory. These germ ideas of reproducing the mental pictures began to develop. The color idea developed first and finally the art of painting came into being. The coloring matter which Nature had collected was assembled and used to reproduce the mental pictures in an enduring form. Perhaps the most perfect, the oldest and the most interesting specimen of prehistoric art is found on a cavern wall near Santander in Spain. It is a painting of an extinct species of a bison bull in the act of charging and it is painted in three colors representing a partial shedding of the long, black hair of winter leaving the shorter, red hair of the springtime. From these beginnings, the arts of sculpture and painting have climbed the evolutionary steps to their present state of development.

There has been development, progress and growth in everything that is made and used by mankind. The development of a useful idea has called into being great industries and they in turn have been torn down and cast into the discard by the development of some other more useful idea. A generation ago the manufacture of buggies gave gainful employment to many thousands of persons. The automobile has been substituted for the buggy, these plants have been changed and the workers directed into other activities. The radio is supplanting the piano; fuel oil and natural gas is fast taking the place of coal; the motor buses, private automobiles and the airplanes are furnishing means of transportation that the street cars and railroads once supplied. These changing conditions of society have led to specializa-

tion and development in certain kinds of work for a great mass of the human family in all civilized and progressive countries. It has made them more dependent than independent and has taken much of the individual initiative from them so that they are less able to care for themselves in their struggle for existence as these changing activities of society take place. This is because their natural environments have been largely removed and they are living unnatural lives. This is one of the penalties of the "Machine Age." The question is worthy of our consideration whether the art that man has developed will not in time destroy the civilization that it has built? But the evolutionary law of adaptation will, in time, adjust the habits of mankind to every beneficial change that Cultural Evolution may develop.

CHAPTER XI.

Developing the Art of Music.

HUMAN emotions are, to a certain extent, the same throughout the entire world. The charms of music appeal to all mankind. They appeal to the savage, though to a lesser degree, perhaps, the same as to the cultured. It has been written that: "Music hath charms to soothe the savage breast." Some of the lower animals are affected by its charms. Dogs will sometimes stand and howl, bears and monkeys will dance as an evidence of its effect on their emotions. Musical prodigies, in some cases, will leave the hall, after hearing the rendition of a great concert or opera, overcome with their emotions and apparently in a trance. Poets have sung of its charms throughout the ages. Mythological stories were invented and written describing its compelling force. Its origin has been ascribed to mythical beings. Physical experiments have been made which show that the vibrations of harmonious music will produce, on certain fluid films, beautiful and fantastic forms, and designs, all moving in harmony and unison and apparently controlled by physical laws, while a few harsh and rasping notes completely destroy these beautiful designs.

Physicists tell us that music is a mode of motion; that sound, the raw material from which music is fashioned, is produced by motion and that it is a modification by art of aerial vibrations; that these vibrations, such as are audible

to the human ear, have a rapidity which ranges from 16 to 36,500 per second. As a matter of comparison of some of the different vibrations, heat vibrations begin at 134 trillion per second, while light vibrations, visible to the naked eye, begin at 483 trillion per second. Many others are so great that they are beyond our sense perception. It can thus be readily seen that sound vibrations are the slowest of all.

A demonstration of the process of vibration may be made with a piece of string or wire. When it is tightly stretched and undisturbed, it represents a straight line. When it is plucked or scratched, it is bent out of its course and forms a curved line or segment, and its elasticity causes it to return to its former position. This is a single vibration. But because of the momentum it has acquired by being disturbed, it does not stop when it reaches its former straight position but it goes in the opposite direction, thus forming another curve, the same as the first curve produced but in the opposite direction. This makes a double vibration. The vibrations thus produced are isochronous; that is they occupy exactly the same length of time. By shortening or lengthening the strings, we get vibrations of different velocities, thus determining the pitches of the vibrations. The same acoustical results may be produced with pipes or wind instruments of varying lengths. All the qualities of music depend upon the rapidity of the vibrations.

It is demonstrated that these vibrations are governed by mathematical laws; that the number of vibrations of strings is inversely proportional to their length; that they are in inverse ratio to their diameter; that they are inversely pro-

portional to the square root of their density. Here again, the laws of Nature are woven into the fundamental fabric of music, which is, after all, just another method of interpreting the laws of Nature.

Beauquier says: "Musical vibration is only one particular mode of perceiving the universal vibration. Musical art is the art of sensibility par excellence, since it regulates the great phenomena of vibration into which all external perceptions resolve themselves and transfers it from the region of the unconscious, in which it was hidden, to that of consciousness." When we shall better understand the processes involved in the vibrations that control our nerve actions, we shall then better understand its stimulating or soothing effect upon human emotions in leading soldiers into battle, the bride to the altar, and intoning the grief for one dying or dead.

It is the most complex and yet the most highly and completely developed of all the Arts. Some writers of recognized authority assert that some phases of musical composition have reached a state approximating perfection. Crowest, one of the most trustworthy of these, in speaking of Handel's masterpiece, "The Messiah," says, in "The Story of the Art of Music," "The Messiah supplies the perfection of oratorio." "After him, however, choral music could be taken to no greater heights." "So far as sacred choral art was concerned, no composer could hope to surpass Bach and Handel." Time alone will tell whether or not these statements are extreme.

Music is a combination of sounds blended in harmony. It has its origin in the action of Nature. It is man's attempt to garner all the sounds of Nature and to regulate and control them. It is his attempt to imitate the voice of Nature. We have the elements of all music about us as we walk through the fields and forests. The singing of the birds is an expression of their joy and happiness. The sighing of the wind through the tree tops, the humming of the bees, the chirping of the crickets, the singing of the insects, the croaking of the frogs, the murmuring of the streams, the rumbling of the waterfalls and the roar of the thunder are all elemental forms of music. Primitive humming, whistling and chanting were, perhaps, man's first attempt to imitate these sounds.

The Evolution of Musical Instruments.

Primitive man learned that he could not reproduce all the sounds of the voice of Nature with his vocal organs and that there were other ways of imitating these sounds. In prehistoric times, he made his living largely by the use of the bow and arrow. He learned that he could strike a more telling blow and at farther and safer distance with a flint tipped arrow propelled by the quickly released tension of a bow than he could with his hands or with a club. His bow was bent with a string made from the hide or tendon of some animal that he had killed. When the bow string was released, there was a twang and a vibrating humming noise. He made use of all parts of the animals that he killed. Their skins were dried and tanned and used for

shelter or for clothing. They were stretched over hollow logs, sea shells, or other hollow objects in order that the air might reach both sides in the tanning process. When the dried skin, stretched tightly over some hollow object, was struck with a stick or stone, it produced an echoing sound, a sound of percussion. He also made use of the horns and large bones of the beasts he killed. They were used as household implements, such as awls, spoons and drinking cups. When air from his lungs was blown through these hollow horns, it produced a bleating sonorous sound that would carry far and could be heard at a greater distance than that of the human voice. The beating of the dried skin stretched over some hollow object was the principle of the drum. The twanging of the bow string was the principle of the stringed instrument. And the blowing through the hollow horn was the principle of the wind instrument. No other basic principles are involved in the entire scope of musical instruments. With the discovery of three methods of producing sound vibration, the foundation for the entire universe of music was completed.

Instrumental music, as we know it today, is of comparatively recent origin. At best it dates back only 200 or 300 years, but prior to that time, we can figuratively trace its embryonic processes of growth, as in organic development, back to the first germ. A great orchestra tells the entire story. It is made up of, perhaps, eighty or more persons ready to execute their respective parts. They are all skilled in the art of music. Some of this group are from Russia, some from Italy, some from Germany and some from

America or other countries. They speak different languages and some of them do not understand what others of the same group are talking about. They are arranged in separate groups and before them are many kinds of musical instruments. These are arranged in different groups. Many of these are so made that it is necessary to blow through them in order to make a sound. These are of various sizes and shapes. They are called wind instruments. Some of these instruments have strings stretched across their surface and these strings are either set in motion by scratching or plucking. They are fastened at one end to pegs or posts so that the tightening or loosening of the string may be accomplished by turning the post. This is done in order to produce the proper vibration. Others are made up of the skins of animals stretched over a hollow chamber. These are called instruments of percussion or drums. Before each of these performers are sheets of paper upon which are printed strange and curious symbols. There are horizontal lines extending entirely across the sheets. There are dots, dashes, bars and many other symbols. To the persons unschooled in the purpose of these strange markings and symbols, they are as meaningless as are Egyptian hieroglyphics. But to the musicians assembled, they are characters representing a common language. These persons have spent the greater part of their lives studying these characters and learning their meaning. These characters were first aranged by some great composer and these musicians are about to interpret their meaning with the use of the instruments before them. The rendition of some great masterpiece begins. The har-

monious vibrations of Nature are set in motion. Our nerve centers are aroused and rejuvenated and our emotions are charmed by the vibrations we are hearing.

"From harmony to harmony
This universal frame began.
From harmony to harmony
The diapason closing full in man."

This is a heritage from the ages.

We have been listening to the voice of Nature interpreted and reproduced by man through agencies made by man. The peculiar characters and symbols recorded on the sheets of paper are characters representing a sign-language, a language through which music can be spoken and understood. These symbols are the results of evolutionary growth throughout the centuries. In the early times, the letters of the alphabet were used as scale measurement markers. Next came the neumes—from the eighth to the twelfth century, which were characters used principally to denote a rise and fall of the voice. Finally our present system of notes has come to us through a long period of gradation. Likewise, all the musical instruments have come to us through centuries of experiments by thousands of patient workers. They are the results of trying out, comparing, eliminating, adding to and changing in our effort to more nearly reach perfection. Egyptians, Hebrews, Assyrians, Greeks and Romans were the leaders in ancient music, but their instruments were of the crudest kinds. They consisted largely of harps, flutes, trumpets, lyres, drums, tambourines and cymbals, but with these crude instruments, the Egyptian orchestra had a reach

of four and one-half octaves—more than one-half of our full orchestra of today.

If we shall examine any stringed instrument of today, we will find that it is only an evoluted form of the vibration of the bowstring. When primitive man discovered that there was the harmony of sound in his bowstring, it is only reasonable to suppose that he tied on another string and then another; that he bent the bow still more and added other strings until he produced the harp as is evidenced by the ancient drawings of the harp. The wind instruments of today are evoluted forms of the first primitive horn used by primitive man which he had taken from some beast. The principle of blowing through a horn or hollow tube to produce sound has not changed but the forms have changed a thousand times. The drum is the simplest of all instruments and at the same time the oldest. Every savage tribe on earth today makes use of the drum in their religious or social rites. Rowbotham in "History of Music," p. 2, says: "Never in the musical history of mankind is the lyre stage found to precede the pipe stage, nor the pipe stage to precede the drum stage. That this should be the order of development seems natural if we consider the mechanical complexity of the instruments themselves. The drum is evidently the simplest of all; the pipe is more complex than the drum; but the lyre, which consists of strings bound around pegs and strung on a frame, is the most complex of all." We must therefore conclude that the drum is the least evoluted of all instruments and that with a few changes, it

represents the dried skin stretched over some hollow object as prehistoric man first made use of it.

Many volumes have been written showing in detail the various steps that have taken place in the various branches of music in order that it might become the highly developed Art that it now is. It is sufficient here to show that, like all other branches of Art, it is the result of development and growth and that it is a part of the Universal Plan.

CHAPTER XII.

The Unity and Application of Art.

WE have seen that Art represents the changes that man has wrought in the forms of things that Nature has created, and, while the forms have changed, the substance remains the same. There is an art collection in every home regardless of how humble it may be. Since man conceived the first idea of changing the forms of Nature and making them more fitted to his use, every step in human progress has been motivated by a desire to eliminate time and shorten space and to add to his comfort, convenience and happiness. In a modern home a collection of the developed thoughts of the ages may be found where their application is administering to the comfort, convenience and happiness of all who share its shelter. It is here that the heritages of the present and preceding generations are assembled. The useful arts have become so commonplace that they are not generally classed as art but they are, nevertheless, the product of changed forms of Nature made useful to mankind.

There is no place where the application of the arts may be more clearly demonstrated than in a modern home. Let us analyze the things we find in use in such a home. We drive to the home in an automobile. It is made of many materials and of many parts. The tires are made of rubber that is produced in tropical climates. Its production furnishes a means of livelihood for many of the human family.

But the tire is not pure rubber—it contains other materials such as carbon, cotton, etc. The carbon is made mostly from the carbon particles that have been burned out of natural gas. Thus carbon represents another industry that has changed it from the forms in which it is found in Nature. The cotton fabric is produced from the fiber of a plant which is cultivated, gathered, ginned and woven into the forms necessary to make it useful. These changes all represent various steps of evolutionary growth.

The tire is fastened to a steel rim which represents another industry that has been 3,000 years in the making. The rims and spokes are made of wood which again represents one of the oldest industries known to man. The seats are covered with leather or with cloth, it matters not which, because the leather represents the first artificial clothing used by primitive man who developed the art of tanning before written history began, while the cloth represents another early art, that of weaving, which again is older than written history. The metal trimmings represent various phases of the metal industry, the paint another industry that has grown and developed since primitive man painted images of the now extinct bison on the cavern walls of Spain more than 50,000 years ago. The glass in the windshield, doors and windows represent another branch of art that has developed through the ages.

Again, we find that the automobile carries a miniature electric light and power plant that enables travel by night, furnishes power to start the motor, and constant spark for the ignition system. This is the nerve system of the machine.

The motive power comes from gasoline and is produced by small explosions taking place within enclosed cylinders, the power from which is transmitted through shafts and gearing to the point where locomotion takes place. But what is gasoline? It is a liquid substance, highly volatile, composed of hydrocarbon particles that will explode when changed to a gas and mixed with air when a spark is applied. It is liquid sunshine stored away in the hidden recesses of the earth's rocks millions of years ago. Its discovery and utilization has grown into one of the largest industries in the United States. It is a part of the Universal Plan of Creation. It is a changed form of animal and vegetable life, which in the economies of Nature, was stored away when the earth was young and there held in reserve until Cultural Evolution had prepared civilization for its use.

Before we reach the house toward which we are traveling, we find that the automobile in which we are being transported represents many varied industries that give employment and furnish a livelihood to millions of human beings. It represents a combination of constructive ideas that have been accumulating throughout the ages and now assembled into one useful machine. It is not the product of any one mind, age or industry, but it is a product of the constructive thoughts of millions of human beings who have changed the forms of Nature in order that they may be adapted and applied to the uses of man. It is a device of his making that eliminates time, shortens space and adds to his happiness, comfort and convenience.

We approach the house. It is made of vitrified bricks. They are cut and moulded in the same shapes as were those of the ancient Babylonians thousands of years ago. They are bound together with mortar made of sand and cement. Experience has taught the builders that by baking the clay bricks in a furnace under high temperatures for a long period of time, the clay will become vitrified and more durable, that they will withstand the elements better and hence the discard of the sun-dried bricks of the ancients. The roof is made of asbestos shingles. This material has supplanted the dried skins of animals used by primitive man, the shingle or clapboard roofs of our grandfathers, the tin and tile roofs of more recent years, because asbestos is lighter, more durable, fire-proof, more permanent and is not affected by the elements. The windows are larger and more artistically arranged thus providing for more light and ventilation. The architecture and landscaping is a design of beauty. The house thus constructed is both beautiful and durable, and its appearance offers a suggestion of happiness and comfort. It is an adaptation and modification of the building ideas that have been developed throughout the ages of our civilization.

On entering the house we see a beautiful piano. It has ivory keys which may be connected to wire strings of varying sizes and lengths. Its case or frame is made of the choicest mahogany or walnut highly polished. In a convenient rack there may be found sheets of paper upon which are printed characters expressing a universal language. It is an instrument from which melody and harmony may be extracted, by

one trained in its use, which appeal to the emotions of the human heart. It again represents the changes man has wrought in the forms of Nature in order to add to his pleasure and happiness.

It represents centuries of growth and many applications of new ideas. It is the evoluted form of the vibration of the bowstring first observed by some primitive ancestor when civilization was, as yet, in an embryonic state. It is the compounded principle of the harp of the Egyptians, Babylonians and Greeks, the lute of the Middle Ages, the harpsichord of our grandfathers and its perfection has come within the period of the lives of those still living. The characters on the sheets of paper whose symbolic meaning must be understood and followed in order that melody and harmony may be developed, represent the evolution of the universal language that gives to music its interpretation. Each line, space, dot, dash and note has its own evolutionary development.

In an adjoining room is another instrument. It is neither a stringed, a wind, nor a percussion instrument, and yet these are all combined into one. It is a re-creating instrument that has become the most universally used of any instrument known to civilization. It is truly a "heritage for the ages." It gathers from the ether waves and re-creates the music of all times and people. Not only does it re-create music, but it re-creates the human voice from all parts of the world. It is a world-wide messenger that brings information and advice from all civilized countries. It has no barriers of distance and its parts are made up of materials that have

been gathered from many places. It is the greatest of all modern miracles and it has made the world one big neighborhood. It carries both music and messages to millions of people each hour. You may tune in or turn off just as you choose to do.

The vibrations of the ether waves have carried every sound made by man, beast, bird or the elements since the world began. Each generation has developed and applied new thoughts and as our experience in living has lengthened it has remained for the present generation to develop the radio.

On a table is another instrument. It is a telephone, an instrument of communication. It also is made of many parts and many different materials that have been produced and gathered from many places. It is, or may be, connected instantly with millions of other telephones throughout this and foreign countries. It carries the human voice around the world, unchanged, with the accent and individual sounds peculiar to the person speaking. It shortens time and eliminates space but it is not the result of one mind or of one age. It is the result of a desire of man to communicate instantly his thought beyond the natural range of the human voice. It is the evoluted idea of the primitive system of signalling wherein human thought was first conveyed beyond the range of the voice by means of drums or the brush fires on the hilltops. Like Organic Evolution it still retains vestiges of the earlier forms through which and from which it has developed.

We may now look upon this means of communication as another modern miracle but who knows what the next age or ages of our civilization may bring forth? It may be possible that the future shall bring forth a delicate sensitive instrument that can be carried in a pocket of one's clothing the same as a watch is now carried, and by the use of which individual communication may be carried on without the connecting wires now necessary with the regular telephone.

A fire is burning in the fireplace. A blue blaze is racing over an asbestos grate. There is no smoke and the fuel is neither wood, coke nor coal, but instead, it is natural gas, the only perfect fuel known to our civilization. The gas is coming from the hidden recesses of the earth's rocks some, perhaps, a mile in depth beneath the surface of the earth. It may be coming from a hundred wells or more and from a distance of a thousand miles away. It is being transported through iron pipes to the place of its consumption. If the gas fields are reasonably close, it is transporting itself to market in an effort to expand. This is the one fuel that furnishes instant heat. Thousands of human lives have been offered as a sacrifice in discovering how to reduce to possession, use and control this valuable fuel. But what you see burning is, in many cases, only a residue product. The gasoline content in most cases has been extracted from this gas before it has reached the burner tips in the fireplace before you. Hundreds of thousands of people are engaged in the industry that makes it possible for the furnishing of this fuel in this home. The first spark of fire struck from a piece of flint by our primitive ancestors that started combustion

in some dry substance was the beginning of this cycle of developing heat that ends in the grate before you, where the "spirits" of the earth's interior are being changed into an agency of convenience and comfort.

On the mantelpiece there is another instrument. It is a clock that is measuring the days and nights into hours, minutes and seconds. The year is measured by the time it takes the earth to complete one revolution in its orbit around the sun. The month is measured by the time required for the moon to revolve around the earth and the day is measured by the time required for the earth to make one complete revolution on its axis. We thus see that the longer periods of time are measured by the movements of the heavenly bodies. But as our civilization began to become complex, the necessity for shorter divisions of time presented itself.

Perhaps the earliest effort made by man in solving this problem was in the use of the sun-dial, or shadow clock, but like the early attempt at communication by the signalling system, the sun-dial was useless at night and on cloudy days. Next came the fire clock, the water clock and the hour-glass. The Chinese, Greeks and Romans used the water clocks and during the Middle Ages the weight clock came into use. The next step in the evolution of the clock was the use of the pendulum. It will thus be seen that our modern clock has passed through a cycle of centuries in its development.

If we shall examine the bathroom, we will find beautiful bathroom fixtures where clear, sparkling water may be had by the simple process of turning a faucet. It comes to you

under pressure from some storage reservoir where it has been chemically treated and the bacteria therein destroyed. It has been inspected by the health department and is free from disease germs. Not only is it fit for the bath but it is satisfactory for cooking and drinking purposes as well. The open well and "The Old Oaken Bucket" have been cast into the discard as a greater safeguard in the interest of health, but yet, they are beautiful memories.

As darkness comes on, a button is pressed and there is instant light developed in incandescent light bulbs. It is energy transported or conducted through wires from some distant plant where the power is generated. Perhaps this electrical current is generated from the power of falling water and then transferred to the wires that conduct it to the light bulbs where it is used in creating light. Where an electric current may be had, the grease lamp, tallow candle and the kerosene lamp have disappeared. They have run their course and served well their purpose but as civilization advanced, they have given way to the better, more instant and convenient uses of electricity. Not only does this energy furnish light but it also furnishes power to run the washing machine, sewing machine, vacuum cleaner, fans, refrigerator, radio, stoves and other electrical devices.

The use of electricity is doubtless in its infancy, but what the future generations may bring forth in the further development of power that will supplant that now in use, is not given to man to know. It is given to him to uncover the hidden secrets of Nature and to adapt them to his use as he needs them.

We go next to the library and find hundreds of books stored away in cases. They are bound in paper, leather and cloth. The bindings are artistic and beautiful but the content of these books contains a record of the achievements and doings of man dating back thousands of years before written history began. The combined, constructive thoughts of all men of all ages are recorded in these books. They are recorded in a written or printed language. This language is made up of sentences each expressing a thought. The sentences are made up of words and the words are made up of characters. Each character represents an idea and these characters have each passed through many changes in their development. They are the changed forms of the hieroglyphics of the Egyptians and the cuneiform characters of the Babylonians. They have been combined and changed by the Phœnicians, Greeks and Romans and worked into their present form by the more recent generations of men from whom we have descended. They record events reaching back to the horizon of written history. Through the imperishable tools and implements that primitive man has left as fossil evidence of his doings, we learn many things about early man dating back to the time when he invented the first bow and arrow and chipped the first flake of flint. Every known living thing is here given a name and is classified. All the changes wrought in the forms of Nature are here recorded.

Cultural Evolution proves itself beyond any honest, reasonable doubt. Searchers are daily adding cumulative facts to this storehouse of knowledge. New secrets of

Nature are being discovered and recorded with each succeeding year. But the end is not yet for we are just in the beginning. It is a part of the Creative Plan that man should continue searching until the hidden secrets of Nature shall be unfolded and understood.

There are oriental rugs on the floors, beautiful in design and rich in coloring, that represent a finished art of a people with whom patience is a virtue and who know nothing of the economies of time. The tapestries and table covers represent the work of another group of persons who have attained near perfection in the art they follow. The vases, furniture, dishes, lamps, oil paintings, table linens and other articles of household use have all been developed from the crudest forms to their present state of advancement with the experiences of the preceding generations woven into their present construction.

The kitchen floor is covered with linoleum. If we shall analyze its structure, we will find that it is made of many materials such as oxidized linseed oil, known as linoleum cement, various gum resins, ground cork, pigments, jute, etc. All of these materials have been gathered from Nature's storehouse from many parts of the world and the thoughts, experiences, and hands of many thousands of persons have woven them into a durable, waterproof covering for the kitchen floor.

There is a gas cook stove and also an electric stove in the kitchen and on the rear porch or in the basement, there is an electric refrigerator. The same current of electricity that is coming through the copper wires from the power

plant is furnishing heat for cooking, light for illumination, and is freezing ice in the refrigerator, all at the same time. Like the natural processes of the same grass in the field producing wool from the sheep, milk, hair, horn and muscle of the cow, and the same soil in the garden producing the different vegetables and flowers, so Cultural Evolution has adopted the products of Nature, changed their forms, and applied them to the uses of man.

Thus has human society been bound together. Each person or group depending on the other. Step by step, the procession has marched throughout the centuries, each generation leaving something that the preceding generation did not have. The work of a genius may be noticed here and there. It is the work of a person who has noticed something that no other person has noticed and who has created new forms that no other person has created. They are useful and helpful to mankind. They are adopted and become of general use. They are now a part of human progress and a part of Cultural Evolution.

PART TWO

CHAPTER XIII.

Organic Evolution.

IT has been shown in the preceding chapters of this book that human civilization is the result of growth and development and that there was a time in the age of man when civilization did not exist; that every aid that man has called into use to assist him in his struggle for existence may be traced to its proximate or ultimate origin. In the regular sequence of a story of Evolution what has heretofore been written should follow what shall be written in the subsequent pages, but the transposition of the subject matter has been purposely made as a means of clarity and as a foundation for better understanding the laws of Nature working through the Plan of Evolution.

In entering upon a discussion of the evidences of Organic Evolution, we are brought face to face with the questions that have disturbed the minds of so many millions of persons, namely: What was the plan of creation? Was it, as taught in the ancient Hebrew writings, an act of God that extended over a period of six days? Or was it an act of God that has extended over many millions of years?

The late William Jennings Bryan who believed in the "Special Creation" plan, in his lectures used these words: "If it could be shown that man, instead of being made in the image of God, is a development of beasts, we would have to accept it regardless of its effect, for truth is truth

and must prevail." Upon the premise that "truth is truth and must prevail," the story of Organic Evolution is indelibly written.

Almost every race and tribe of primitive people had a legend accounting for the origin of the world and of its inhabitants. With the more primitive tribes, these legends were handed down from generation to generation by word of mouth and were added to and changed until they became unreasonable myths. Their minds were childlike and they were as easily persuaded as are children. They were over credulous and ready to believe almost any unreasonable story. The belief in a Santa Claus is as real in the minds of children of today as if this mythical person really existed. Even the educated grown-up people of today still cling to vestiges of superstitious beliefs as is evidenced by Halloween and New Year's demonstrations. As an evidence of these stories, we have the mythology of the Greeks and the legends of the American Indians as well as the mythology and legends of many other primitive people. The oldest of these recorded legends are, naturally, found among the people first using a written language. The ancient Hebrews had a collection of documents which gave an account of the origin of the world and all things therein. Some of these documents have been collected into a book known as the Old Testament Bible. It is in Genesis, the first book of the Old Testament, that the Hebrew account of the origin of the world and its inhabitants is recorded. It begins with the statement: "In the beginning God created the heaven and the earth." It is understood to teach that the world and all

it contains was created about 6,000 years ago; that the work of creation covered a period of six days; that Adam was the first man and was created on the sixth day; that Eve was the first woman and that she was formed of a rib taken from Adam while he slept; that both Adam and Eve were created of full stature, capable of speaking and understanding a language; that Adam lived nine hundred and thirty years and that some of his posterity exceeded that age; that Adam named all living creatures; that the earth was created before the sun and that the sun and moon were created on the same day; that after a period of 1,656 years a great deluge destroyed all the descendants of Adam except Noah and his family and all animals except a pair of each that were preserved in the "ark" with Noah and his family; that all the different races of men are descended from Noah.

With the exception of the first statement in this Hebrew account of creation: "In the beginning God created the heaven and the earth," which is a declaration of the supernatural origin of all things, all the other propositions relate to matters affecting the order of the natural world. Evolution does not take God out of the universe—far from this! It does not dispute the supernatural origin of all things. Theistic Evolution teaches that we must turn to the Divine Creator to find the origin of life; that Evolution is only a method. It is not an agent. It is only concerned with the method of creation and makes no attempt to explain the origin of life. It gives a description of the method of creation and stops with this. It matters not whether man was made out of protoplasm or dust, the result is still the same.

All arguments in an attempted explanation of the origin of life lead only in a circle. If man was made out of protoplasm or dust, then the question naturally arises—who made the protoplasm or dust?

It matters not whether man was created in an instant or in ten million years, the result is still the same. Genesis recites: "And God said, Let us make man in our image, after our likeness." Bible scholars tell us that this is not physical and has no reference to the body, but to the spiritual side of man. The traditional belief was that God had a body and sat on a throne, whereas our modern conception of God is that He is a spirit and therefore our possible likeness to Him is in moral and spiritual attributes.

It must be remembered that the Bible is a book of Religion and not of Science. It is the most permanent foundation of the conduct of men and deals with the moral and spiritual progress of the human race. Matters affecting the moral and spiritual affairs of men are subject to our religious beliefs or ideas of God and His relation to the universe and they are largely a matter of personal faith. Matters affecting the natural order come directly within the field of direct observation and are subject to proof. The Hebrew conception of creation was that of the work of a master magician, while that of Theistic Evolution is that of a living, immanent, ever-working God. It teaches that nothing has come by chance but that creation is a marvelous order which has been worked out and is being perfected through natural law. No child should be taught that the Bible tells the story of Nature as it has been revealed to us through the

centuries of observation and research. In studying the method of creation, we should look at the universe as men see it today and not as the ancient Hebrews saw it with their limited vision.

Many erroneous traditional beliefs have been shattered when the light of truth came to the knowledge of man. Many honest and well-meaning students of the Bible have brought about a misunderstanding of the Hebrew story of creation simply because they were ignorant of the facts surrounding natural law. Doctor Lightfoot, one of these Bible students wrote: "Heaven and earth, center and circumference were made in the same instance of time, and clouds full of water, and man was created by the Trinity on the 26th. day of October 4004 B. C. at 9:00 o'clock in the morning." In the museum rooms of some of our eastern universities, there are now ancient writings whose origin are definitely proved to date back to 6000 years B. C.

The facts that Cultural Evolution have developed during the past century of observation and research concerning the earth and its inhabitants are so well known and furnish such an array of positive evidence, that they form the foundation for the statement that Organic Evolution has passed out of the realm of hypothesis and theory to one of scientific fact. It now takes its place with the other great discoveries of the laws of Nature. It is now taught in all the great universities of the world both state and secular. It should be taught in our schools simply as the story of Nature. This simple story is full of moral and spiritual force. Its moral principle is that nothing can be gained in this world without

an effort. The spiritual principle of Evolution is that of beauty, order, design and harmony and that in all things Nature is seeking perfection.

At the time the book of Genesis was written, the Hebrew people and their contemporaries were very limited in their view of the universe and all it contains. They saw it with the naked eye and without the background of centuries of careful observation and research which we now have. They believed that the earth was flat instead of round; that the earth was the center of the universe. This same belief was perpetuated by Ptolemy whose teachings satisfied the minds of the peoples of the earth for a period of more than fourteen hundred years. These teachings were that the earth was the center of the universe and that the sun, moon and stars revolved around it. Aristotle taught that the earth was a globe suspended in space; that it was the center of the universe around which the sun, moon and stars revolved. Great thinkers had begun to direct their thoughts to an understanding of some of the laws of Nature.

In the early part of the sixteenth century, a young Polish astronomer, Nikolaus Copernicus, developed a theory that the sun is the center of the universe and that the earth and the planets revolve around it, and that the moon revolves around the earth. He was a man seventy years of age and on his death bed when his book was published proclaiming his solar theory. The Church objected to this theory as being contrary to the teachings of the Bible. Then came the discovery of the Law of Gravitation by Newton, and Galileo with his telescope proving the solar theory of Copernicus to

be correct. A traditional belief was shattered. The Church of the Middle Ages condemned the teachings of Galileo because his teachings were contrary to the Bible. He was forced to retract his statements under penalty of death. He had to deny the truth for awhile to save his neck from the brutal guillotine and his head from a basket of sawdust. Next came the great Kepler with his discovery of the laws of the planetary movements, showing the wonderful precision, balance and uniformity running through the movements of all heavenly bodies. Scientists tell us that this balance is so perfect that every leaf that falls from a tree affects the movement of the most distant star.

It is only proper to inquire: Which is better? To blindly believe with the ancients that the earth is flat; that it is the center of the universe; and that the sun, moon and stars revolve around it; or to use our God-given intelligence in searching out the truth as to the Plan of Creation; to gaze into the infinitude of space and to see the billions of heavenly bodies floating therein all regulated by infallible laws; and try in our finite way to comprehend the infinite Mind that conceived and created all this? The majesty of God was voiced by the Psalmist when he exclaimed: "The heavens declare the glory of God and the firmament showeth His handiwork; day unto day uttereth speech and night unto night showeth knowledge."

The discovery of Truth is the greatest duty imposed upon man in the Plan of Creation. Otherwise, he would have been endowed with a knowledge of all Truth. Without Truth we see blindly. If Science is able to show us a little

more clearly just what the Plan of Creation is, we ought to be very grateful to the persons who spend their lives in the laboratories and observatories searching out and charting before our eyes and the wonderful plan of which we are a part.

We live and move and have our being under Natural laws. These laws are unchangeable and they were the same in the beginning of our existence and they will be the same a million years hence. It is our duty to know, understand and obey them. If we shall fail to do this, we will pay the penalty of violation.

Aside from the statement of the supernatural origin of all things as set forth in the first chapter of Genesis, the other and above-mentioned statements are all concerning subjects that may be examined and analyzed in the light of facts and knowledge that have been accumulated throughout the ages of man's existence. The test of their truth must be determined by scientific methods. They are secular truths and therefore must stand the examinations applied in testing other similar statements in determining their truth. These statements all pertain to matters about which the experiences of mankind may be applied in determining their truth.

The declarations in the book of Genesis that the world was created about six thousand years ago and that the creation of the world and its inhabitants and also the sun, moon and stars covered a period of six literal days are statements of fact concerning physical matters whose truth is not self-evident. In order to establish the truth of these statements,

they must withstand an examination based on the logical, cumulative observations, investigations and experiences of man throughout the entire period of civilization and still remain undestroyed as to truth. If these statements cannot be disproved by all the accumulated knowledge possessed by all mankind, then they are accepted as true. On the other hand, if these statements are contrary to well-known natural laws and well-established scientific facts, they must fall because they have no foundation in truth.

The secular statements contained in the book of Genesis relative to the age of the world and of man, of the method of creation, of the deluge, of the longevity of the lives of the early Bible characters, of the destruction of all life except one family and the animals with it in the ark, are all amenable to proof and must be examined in relationship with the established facts of geology, astronomy, anthropology, ethnology, archæology, and other branches of Science.

Since Science has proved by reasonable conclusions that the age of the world is many millions of years, and has traced in an unbroken line the life of some of its creatures for a period of millions of years, and has established the fact of man's evolution from a lower order of creatures, the story of creation as recorded in the book of Genesis must be taken as poetic instead of being a literal truth.

Dr. Alexander Winchell, a great scientist, author and Bible student, in his book: "Preadamites" page 456, gives his ideas of Bible interpretation in these words: "I maintain, against the narrow and pernicious dogma that the Bible is

sufficient everywhere to interpret itself, that, on the contrary, it was ordained to be interpreted under the concentrated light of all the learning which has been created by a God-given intelligence to man. I believe the biblical documents, so far as dictated by inspiration, have been written for all time; and that their meaning is so often so deep and so rich that the accumulated learning of the latest generation of men will be unable to exhaust it.

"The pretense that the Bible must be interpreted grammatically and Hebraically, without scientific aids, is an implicit denial of its divine inspiration, and is one of those self-destructive claims which a blind faith is ever setting up against the demands of common sense."

Since the Bible is a book of religion it is well to take the testimony of those best qualified to speak on the relationship of Evolution to Religion. Dr. Henry Drummond, a great naturalist, author, and minister, whom Dwight L. Moody characterized as the "greatest preacher in the world," in his book: "The Ascent of Man," pages 341 and 342, published in 1894 in the days of Evolution's dawn, harmonized Evolution and Religion in these words: "Is Nature henceforth to become the ethical teacher of the world? Shall its aims become the guide, its spirit the inspiration of Man's life? Is there no ground here where all the faiths and all the creeds may meet—nay no ground for a final faith and a final creed? If all men could see the inner meaning and aspiration of the natural order, should we not find at last a universal religion congruous with the whole

past of Man, at one with Nature, and with a working creed which Science could accept?

"The answer is a simple one: We have it already. There exists a religion which has anticipated all these requirements —a religion which has been before the world these eighteen hundred years, whose congruity with Nature and with Man stands the tests at every point. Up to this time no word has been spoken to reconcile Christianity with Evolution, or Evolution with Christianity. And why? Because the two are one. What is Evolution? A method of creation. What is its object? To make more perfect living beings. Through what does Evolution work? Through love. Through what does Christianity work? Through love. Evolution and Christianity have the same Author, the same end, the same spirit. There is no rivalry between these processes. Christianity blended into the Evolutionary process with no noise or shock; it upset nothing of all that had been done; it took all the natural foundations precisely as it found them; it adopted Man's body, mind and soul at the exact level where Organic Evolution was at work upon them; it carried on the building by slow and gradual modifications; and, through processes governed by rational laws, it put the finishing touches to the Ascent of Man."

CHAPTER XIV.

A Little Astronomy and Geology.

MANY, many millions of years ago, at a time so remote that it should be counted in eons instead of years, our sun was much larger and much more volcanically active than it now is. It is a large gaseous mass in a state of constant change and confusion. There is positive evidence that the sun contains more than half of the elements in a gaseous state, of which the earth is composed and scientists believe that it contains all the elements found in the earth. The phrase "our sun" is advisedly used because there are millions of suns all controlled by the same solar laws.

Great changes are constantly taking place in this mass of whirling electrons. The inner disturbances of this seething mass sometimes throw out great masses of expanding gases thousands of times as large as the earth. During the life of the sun, it has thrown off such masses which took on form, and obedient to solar law, formed the sun's planets. These planets in turn threw off a part of their mass which took on form, and still obedient to solar law, formed the moons of the planets.

When we speak in astronomic terms and of astronomic figures, our finite minds fail us for want of comprehension. The sun is more than a million times in volume that of the earth. Its diameter is 866,000 miles and its distance from the earth is approximately 93,000,000 miles. This distance

may seem great but when it is compared to the distances of some of the other planets from the sun, it fades into insignificance. Uranus is so far removed from the sun that it takes it eighty-four of our years to travel around the sun while Neptune is approximately three thousand million miles from the sun and it requires one hundred and sixty-five of our years for it to complete its revolution around the sun. As great as these distances may seem to us, yet they fade into nothingness when compared to the distances of the stars.

The nearest visible star is twenty-five trillion miles away while others are so far away that it takes light from these traveling 186,000 miles a second, more than a million years, to reach the earth. And lo! this is just the beginning of our understanding, for space is limitless and time is eternal. At the present stage of development our finite minds fail us in their comprehension, and we cannot, as yet, understand either space or eternity.

There are other theories concerning the manner in which our earth and the planets got away from the sun, got out into space and there got into balance in the solar system but scientists all agree as to their origin from the mother sun. But let us take the earth as we find it and apply the accumulated knowledge of the ages in trying to discover some of the truth it reveals.

We know that the earth is a sphere approximately 8,000 miles in its diameter, rotating once each day on its axis and traveling in its orbit through space at the rate of 65,000 miles each hour; that it is held in its path by the universal

law of gravitation and that it completes its revolution around the sun once each year and continues on repeating this process; that it has once been a gaseous mass and as it cooled, its atoms formed the elements and the compounds of which it is composed; that it is made up of 88 known elements whose combinations make up everything of which the earth and its inhabitants are composed; that the smallest particles of Nature are the electrons carrying a negative charge of electricity, and the protons, which carry a positive charge of electricity; that these electrons travel in their orbits around their nuclei at the rate of hundreds of miles each second in the same manner that the earth revolves around the sun; that the electrons make the atoms which are so small that they can not be seen even with the aid of the most powerful microscope; that the atoms make up the molecules which are still too small to be seen; that the molecules make up the cells of which all organic matter is composed; that these elements may exist in the form of a gas, a liquid or a solid.

Nothing in Nature is constant. These tiny particles of which all things are made possess the properties of force and energy, the force being the cause of a change in a body and energy is the power that creates the force. Energy is found in many forms all of which may be divided into the two general forms kinetic and potential, while the natural forces that accompany these such as gravitation, cohesion, chemical, electrical, magnetic, etc., are the forces which supply motion and life to the universe. Our earth intercepts less than one two-billionths parts of the amount of energy that

the sun radiates, yet the earth is receiving energy from the sun at the rate of 160,000 horse-power for every man, woman and child living on it. The sun is a star and to the inhabitants of the earth, it is the most important member of our entire solar system because all life depends on it.

There is no known means of estimating the age of the earth prior to the time when stratified rocks began to form since there is no available data upon which a reasonable estimate may be made. Geologic time, therefore, is generally understood to begin when the earth reached its present form and condition. The sedimentary rocks furnish a starting point where estimates may be based on a study of the rate of erosion, the thickness of the stratified rocks and many other physical conditions so that the estimates now made are removed from the realm of mere unintelligible guesses. Any estimate now made as to the age of the earth since sedimentation began to take place may be many millions of years in error because it is not known what different conditions may have existed in the past. But the general conclusion among geologists is that many millions of years—some estimates as low as 100 millions of years, and some as high as 1,000 million years—have elapsed since sedimentation began to take place. Evolution is not concerned so much with the time as it is with the method of creation.

As this great blazing mass of gas from which the earth was formed took its position in the solar system and began its endless journey in space under the control of Nature's laws, it took the form of a sphere and it began to cool. Some of the gases turned into a liquid crust and in the course of,

perhaps, billions of years, the crust became thicker and thicker. While the crust was still glowing with heat it contained all the elements that form the substance of all things found in and on the earth today. In this cooling process, the atoms of these gases began to unite. Two of these gases—oxygen and hydrogen—by uniting two atoms of hydrogen to one atom of oxygen forms water. When the first water was formed, the earth's crust was still so hot that it formed great clouds of steam mingled with air and as this steam was condensed into raindrops that fell to the earth, it was sent back in clouds of hissing steam. This process of change was continued for many millions of years. As the cooling process continued, great volcanoes would belch forth fire and liquid rock from the seething interior of the earth. Again, the earth's surface or crust would be broken and upheaved thus forming the mountain ranges. After many millions of years, the earth's crust became sufficiently cool to retain the falling rain and the water began flowing over the surface of the earth and to form the oceans, lakes and rivers. The rains were constantly beating down the upthrust mountains and the rivers were carrying away and leveling up this eroded material. The rivers were forming the valleys and erosion was now taking place. As the waves of the ocean were beating down the shores in some places, they were building up and leveling them in others.

Some of the igneous rocks that were formed from the cooling gases of the flaming earth were ground into fine particles and some dissolved into liquid crystals by the action of moving water. These were again solidified into different

forms, and thus the process of sedimentation began. During all of these millions of years of grinding, washing and leveling of the earth's surface, it was being prepared for the greatest event that has ever occurred since the universe began—namely, the creation of the first "Life Spark." All the forces of Nature were at work—the electrons, the atoms, the molecules, gravitation, adhesion, cohesion, light and heat waves, chemical and magnetic forces, putting all things in order for the coming "Life Spark." The poisonous gases from the innumerable volcanoes were being purified and were now forming into an atmosphere composed mostly of oxygen and nitrogen, the elements necessary to support life. The atmosphere of today like all other things, has passed through an evolutionary process. The original atmosphere was squeezed out of the materials of which the earth is formed, and its component parts were far different in the early history of the earth from what it now is.

The original oceans were composed mostly of fresh water but throughout the centuries of erosion of the earth's surface, the soluble salts were dissolved and carried by the rivers into the oceans where they are now carried in solution. The original oceans covered many portions of what are now land and the present oceans now cover much land that was once parts of the continents. The drilling for oil and gas in Oklahoma and Kansas has furnished proof that great mountain ranges and mountain peaks lie buried beneath the sedimentary deposits of the grassy plains of these two states.

The temperature of the earth had cooled, the atmosphere had been purified, the earth's elements had been com-

pounded, the mists had cleared away so that the sun's light and heat rays could penetrate to the earth. Sub-vital compounds such as colloids, proteids and liquid crystals which are the essential components of all living things had been formed and the earth was now prepared for the first "Life Spark."

From whence did this "Life Spark" come? It must be admitted that nothing in all the world has come by chance and that up to this period of the earth's history, there was no life of any kind on the earth and that nothing that has life has originated from lifeless matter without the intervention of a Higher Power; that the unchanging laws of Nature were in force and doing their creative work from the beginning; that all things originated from a Creative Force which we call God and that the first Life Spark was created by God and that the plan of His creation was that of Evolution. This conclusion is based on the conceptions of the most intelligent thinkers of the world who have spent their lives in seeking to discover the method of creation—the divine truth as revealed in Nature.

CHAPTER XV.

The Beginning of Life.

BIOLOGISTS believe that the first "Life Spark" came into being more than a thousand million years ago in the form of minute, protoplasmic bacteria resembling the simplest form of life that is now known. It may have been like the Algae, the simplest form of plant life. Since all animal life is dependent on plant life, it is only reasonable to suppose that it was more plant than animal but at the same time, possessing the properties of both. It was a unicellular bit of protoplasm possessing the power to divide itself into new and complete cells. In whatever form it may have been it was the forerunner of all plant and animal life. It was made up of millions of electrons, atoms and molecules each following their established laws yet possessing qualities and power that no other group of electrons, atoms and molecules had ever before possessed. It possessed the power of multiplying itself by division—the power of growth. This is the greatest miracle of all time. It is a thousand times more miraculous than the traditional belief that man was created of full stature, possessing a language, an understanding, and all the attributes and qualities that a full grown man possesses, because the Evolution of this first cell up to man has been traced with reasonable certainty and convincing clearness. From this first cell through the life actions of sensation, digestion, locomotion, circulation, protection, adapta-

tion and reproduction every living thing—both plant and animal has developed. It possessed the potential powers and properties of all life. It was governed and regulated by natural laws. It was the starting point from which the design of all life has been planned. Each epoch or generation has improved upon the one preceding it. Out of the potential power of this first life cell the creative arts and sciences have been developed, the whole culminating in the God-given intelligence of man and into altruism and love, the ultimate essence of the plan of life.

It is a part of the Plan of Creation that man shall know the truth. It is the most alluring and elevating accomplishment toward which the mental energies of man can be directed. But we cannot know the truth without long and persistent work. A knowledge of truth cannot be purchased. It cannot be acquired by wishing or praying and the only way it can be acquired is by long and continued mental digging.

A knowledge of the first life cell or of the electrons, atoms and molecules would have been both useless and impossible with primitive minds because these belong to realms of thought to which the reasoning powers of the primitive people had not attained. It was Cultural Evolution that through long periods of study, observation, adaptation and growth, developed the mind of man to a greater comprehension and understanding of the intricate, yet simple, Plan of Creation as revealed to us by scientific research.

As the mists that clouded the understanding of primitive man cleared away and as development and growth opened up avenues through which the sunlight of truth could pene-

trate, the true Plan of Creation began to reveal itself to the understanding of man. It is still revealing itself for there are, as yet, many mysteries unsolved, and it will continue, through the persistent and sacrificial efforts of man, to reveal itself until we shall know the entire truth for it was so ordained in the beginning.

Educated people of today see and understand the Universe to be one great working system wherein each and every part is related and working in harmony with all other parts; that all these parts are directed in their work by unchanging laws and that each part performs its own creative function. It has been shown in the preceding chapters how Cultural Evolution has changed the forms but not the substance of things in order to adapt them to the uses of man. So Organic Evolution has developed all of life by simply changing and multiplying the first life cell.

The scientist tells us that protoplasm in which the first life cell was originated is made up of certain materials, composed of the atoms and molecules of hydrogen, carbon, nitrogen and oxygen and that these materials are found in both living and dead things; that they are borrowed by living things from Nature's storehouses and then go back to replenish and increase the storehouses from which they came. Again the scientist tells us that the energy which produces action in protoplasm is the same kind of energy as that found in atoms, molecules, in heat, light and electricity, and also in the heavenly bodies. It has been proved that nothing can destroy this energy. Its only change is in its method of work. He also tells us that all bodies in the

universe work on each other, thus preserving a balance without a waste of energy; and that by natural law, it is impossible to create something out of nothing.

In the early days of our knowledge of Evolution as its great truths began to unfold, its advocates were frequently asked: "Why was such a plan of creation used by the Creator?" The answer to this question is now a simple statement of fact—that it is not given to the mind of man to conceive a plan more simple, more perfect, more beautiful and more harmonious than that of Evolution. Its undisputable evidence is before us in all things—in everything we see, hear, smell, taste and feel. We cannot understand the meaning and purpose of life without knowing something of its history and Evolution is the simple story of the history of life. Nothing but divinity could crowd within the walls of a single, microscopic, protoplasmic cell all the attributes of all plant and animal life. It is given to man to trace the process of life but the power of creation is beyond our finite comprehension and belongs to God.

This first life cell possessed the power of growth. It absorbed through its skin water and such bits of matter as would furnish it food for growth. It began to develop a system for taking nourishment and of digesting its food. When the food supply about it was exhausted, it then began to develop little tubes, or feelers so that it could reach out farther for its food. When its bodily structure was developed, it made use of another power it possessed, that of splitting itself into two parts so that instead of a single life cell, there were now two life cells in the world. As each new

cell repeated this process, in a short time, there were millions of life cells each living the same way as the first parent life cell. After the original cell had passed on its life to other cells of the same kind, its purpose in life was fulfilled and it could die for through its power of reproduction, life could go on in the world. As these life cells increased into countless numbers, the environments of some were different from others, just as it is with both plants and animals today. The food supply of some was not as abundant or as easily secured as that of others and as a consequence, the ones less favored in their surroundings, had to perish for lack of food or to become more active and to reach out farther in their search for food. Each reaching out brought about a change in their environment and necessitated an adaptation to the new surroundings.

This movement of change and adaptation has developed growth from a lower to a higher state. Just as adversity and the overcoming of obstacles have developed great men of our time, so the overcoming of obstacles in their "struggle for existence" among the first family of life cells have led to newer and higher forms of life. But there were those life cells whose environments were sufficient to supply their necessary food requirements and other life conditions. These made no effort to change their life conditions and as a consequence, they are living today just as they did a thousand million years ago.

As these life cells were forced by changing conditions to change their environments and habits, there came one of the first great steps in the advance of the process of life. It was

that of the method of reproduction. The Plan of Creation now begins to demonstrate its workings. The sexes came into noticeable being—male and female—positive and negative just like the positive and negative forces of electricity as displayed in the electrons and protons. The plan of Nature is that there must be two parents to an offspring and that the offspring is neither like the father nor mother, but possessing the attributes of both. In plant life, from the Algae to the most highly developed plant, this process of reproduction takes place in the plant through different members of its own body while in animal life this process is the result of the functions of different and separate bodies.

In the earliest forms of life, the process of reproduction, so far as we know, was simply one of splitting a living cell into two living cells; whereas, in the early forms of plant life a group of fully developed cells was developed ready to start their process of development and reproduction at the same time. This is also true of the lower order of animal life where parental care cannot be had. These single cell plants by the aid of different food, water and environments began to form in groups and out of these, there came the earliest forms of compound plant life such as fungus plants, mosses and lichens and some of these in turn developed into ferns. It is generally understood that the earliest life was created in mud or water along the seashore and that the early plant life was what we now know as water plants drinking in its food supply from the water, and the soft accumulated particles of matter. As the seashores changed, many of these plants were left on dry land. Again it was the same problem

of self preservation—of adaptation. The plants thus removed from their environment, must change their habits of living and adapt themselves to their new environments or perish. By adaptation, they developed roots that secured their food and water supply from the ground, and through their leaves, oxygen from the air. As the forms of plant life increased, the struggle for existence became more pronounced. Each plant was struggling to receive its share of food from the ground and to draw its oxygen from the air. It was, indeed, a battle wherein the "survival of the fittest" determined the outcome. Some of these plants extended their body stems high in the air in order to drink in a little more sunshine and thereby gain an advantage over their competing neighbors. Some of the more determined and aggressive plants, not to be robbed of their share of sunshine, and whose bodily structure would not support itself in reaching high altitudes—unsupported, turned bandits in their habits, became creepers using the bodies of their stronger neighbors to which they fastened the supporting tendrils, climbed to the uttermost tops of their stronger neighbors and there smothered and choked them to death. There was then as now, a crowding, pulling, drinking, and sucking of the food substance of the soil and the sunshine from the air. In this struggle for food, water and sunshine, thousands of forms of plant life were choked, starved and smothered out but the stronger survived.

During all the millions of years that this struggle was taking place, there were many changes taking place in relation to the method of reproduction. Nature is striving for

perfection but like human beings, she has made many mistakes. She always profits by these mistakes. In some of the lower forms of plant life, two little chains of cells—one representing the male and the other the female grow together into one forming the first principle of the seed or egg. Others produced "spores" which had the power of perpetuating the parent life. Nature was not satisfied with this method of reproduction. She must develop something better than the fungus plants, the lichens, mosses, creepers and ferns; something that will be of greater food value for the life that is to follow; something that will withstand the changed conditions of soil and climate; something that will add beauty and fragrance to the world; something that will be more useful to Cultural Evolution when its age arrives. Up to this time all plants have been both flowerless and seedless but their lives have not been in vain. They have developed, flourished and decayed and in their decay, they have helped to form and enrich the soil from which all future life will live. A part of the great fern forests have stored away the energy of the sun in the form of coal which again is used by man in aiding in the Plan of Creation.

Thus far all the work of plant life has been in preparation for some higher forms of life. Before we proceed to the higher forms of plant life or to the beginning of animal life, it is well to know more of the part these single celled plants played in preparing the world for the higher life that was to follow. Bacteria are very important living plants. They have adapted themselves to their surroundings and are now present everywhere—in the soil, in the water, in

the air in countless numbers. They are so essential in the Plan of Creation that the higher forms of both plant and animal life, including man, could not live without their aid. No other living things perform a more necessary service to man. There are both helpful and harmful kinds but the friendly or helpful ones outnumber the harmful ones many hundreds of times. Great minds, through scientific research have learned how to destroy and to overcome the harmful ones such as those that cause tuberculosis, pneumonia, diphtheria, typhoid fever and others while at the same time, they have discovered methods of cultivating and increasing the friendly ones. Every plant and animal since the first life cell that has lived, died and gone into decay has been worked up into plant food by these lowly bacteria. Every leaf that has fallen from every tree, every stalk of grass, every lichen, moss and fern, every log, every animal that has borrowed its bodily structure from the soil, the water and the sunshine pays these substances back to rebuild other lives. "Dust thou art to dust returneth" is literally true. There is an endless procession of life and death—of decay and a new life. The farmer plants his fields to corn, clover or alfalfa. These take up the substance from the soil, and oxygen from the air. They are fed to his stock and the refuse is hauled out as manure and placed again on the land. Immediately these bacteria break this up into plant food and the plants reproduce the substance of the parent plants. Thus the endless cycle continues. This process has been going on from the beginning of life and it will continue so long as life endures. Nothing in Nature is wasted. Everything is

created for a purpose. These little bacteria have their work to perform. They are a part of the Plan of Creation and they make a part of the harmonious whole, without which life on earth could not exist.

Many millions of years ago, we know not where nor when, but it was, perhaps, many thousands of years after the appearance of the first plant cell, there appeared in the tropical waters along some ancient seashore a microscopic one-celled animal. It was doubtless like the lowest form of animal life now known—the Amoeba. It is composed of a jelly-like substance and has no definite shape, yet it breathes, eats living food, rids itself of wastes and has the power of reproduction. When it moves it simply extends a part of its body in the desired direction and the remainder of its body follows. So far as is now known it has no mouth nor any definite digestive system. It absorbs its food. When it comes in contact with another life cell, either plant or animal, it wraps itself about this cell and sucks and absorbs its food substance from it and releases as waste such parts as it cannot use. Like the lowest forms of plant life, it reproduces itself by dividing its body into two cells.

Because of the changing environments and food conditions, some of these single-celled animals began to adapt themselves to the changing conditions by combining into groups, by forming layers and double layers of cells. They had learned that in union there is strength. In order to perform their functions in life they developed mouths, a digestive system, a rudimentary nervous system and means of protection against their enemies. By adaptation, change

and evolutionary growth thousands of different forms of squirming creatures came into being. As the Algae developed into the fungus plants, the lichens, mosses and ferns, so the single-celled animals developed into the many-celled animals such as the corals, sponges, worms, brachiopods, trilibites, etc., whose skeleton forms are now found as fossils in the rocks which were once the floors of ancient seas. Both plants and animals traveled the same road in their development. The distinguishing characteristic between the earliest forms of plant and animal life is that the plants obtain their food from dead matter—from the soil direct while the animals obtain their food from living bodies—either plant or animal. Thus all animal life is dependent on plant life for its existence.

But Nature is always struggling for perfection. The plants could go no further without a flower and seed and the animals could make no further progress without a backbone.

CHAPTER XVI.

The Preparation for Higher Life.

THE entire scheme of life is one that is constantly reaching out for something that is higher, better and more perfect. Every effort of Nature is directed to the accomplishment of this purpose. From the first bacteria of plant life and the first protozoa of animal life, there is one harmonious blending of effort and a progressive betterment and adaption of plants and animals to one another.

These changes for the higher and better life may be traced from the algæ to the most highly developed plants and from the first protozoa to man with persuasive and convincing certainty. Before we reach the flowering plants and the vertebrate animals, it is well to observe the preparation for higher life and the blending of all the energies of Nature into one harmonious effort in order that this result may be accomplished. In doing this, it is necessary that the labors of the geologist, the zoölogist, the botanist, and many other searchers be consulted and their findings used to demonstrate the scheme of harmony.

As a method of identifying the different strata of the earth's crust and fossil life therein contained, geologic time is divided into eras and these eras are again subdivided into periods each representing the kind and thickness of the deposits and the kind of life that lived on the earth during the time that these deposits were being laid down. The

oldest of these eras is known as the Archæozoic or the first life. This era is estimated to embrace about one-half of geologic time, or the period since sedimentation began to take place. During this era, no fossil plants or animals are found but there is evidence, based on the substance of the deposits, that the simplest forms of plant and animal life existed during this era.

The next era is known as the Proterozoic or early life. This era is estimated to embrace about one-fourth of geologic time and still there is, as yet, no definite fossil plants found but based on the substance of the deposits covering this era of sedimentation, there existed the simplest forms of plant life. It was during this era that the first known fossil animals made their appearance. These early forms of fossil animals embrace the protozoa, worm, sea scorpions, trilobites and others. The trilobites had advanced to the stage of a three-lobed animal (tri-lob-ites), with a mouth, a head, a protective shell, a digestive system, and a method of reproduction. They inhabited the mud flats of the ancient oceans, lagoons and rivers. In the original matrix of these early animals they may be found in a crawling position with body fully extended. They are also found in a sleeping position doubled up with their tail and mouth touching in the same manner as many of the present day worms are found. This important group of marine crab-like animals has been extinct for many millions of years yet they form an important group and the fossil remains of the more than 1,700 different families furnish much evidence of the development of the various evolutionary steps in early life. This group of animals was the first to develop eyes.

The earlier groups were eyeless as were all other groups of animals that had preceded them. There finally appeared a tiny "eye speck" which in the course of many millions of years developed into a compound eye containing as many as 15,000 lenses. The efforts of Nature to develop an eye to fit the surrounding conditions of early life may be clearly traced. Changing environments changed the plans of Nature and many of the eyes became useless, atrophied and were cast into the discard.

The next great era of geologic time is known as the Paleozoic Era and this is subdivided into periods known as the Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian and Permian. In the Cambrian Period, the first fossil sea weeds are found but there is, as yet, no evidence of any land plants that can be distinguished, while on the animal side of the tree of life, animal forms are rapidly increasing. In the shallow beds of the ancient oceans, sea scorpions, trilobites, corals, clams, snails, starfish, crinoids, sponges, great worms and other forms play their parts in evolutionary development.

In the Ordovician and Silurian Periods great changes were taking place on both land and in the sea. It was during these periods that the first land plants and land animals by adaptation came into being. As the seas receded, the marine plants began to adapt themselves to the changing conditions, to develop and to send down roots into the soil for food and water and to drink in oxygen from the air and the sun's energy as well. It was during these periods also that some of the sea animals cast upon or left on the land, as a matter of necessity, changed their habits to enable them

to continue in their "struggle for existence." Some of these water animals became land insects with hinged joints and wings to aid them in their locomotion. They had legs with which to walk, eyes with which to see, and wings with which to fly, and a nervous system controlling their sensations but still they were invertebrates.

Nature's method of adaptation to meet changing conditions, always was, now is, and always will be the same. If a limb be cut from a willow tree and the cut end stuck into the soft mud along the shore of a river, pond or lake, Nature, in order to preserve the life force contained in this limb, immediately sets to work to adapt this limb to its new surroundings. It can no longer depend on its parent body to carry it food and water from the soil and consequently, through its cell intelligence, buds are formed on that portion of the limb that is buried in the mud that develop into roots performing the same functions that the roots of the parent tree perform. The limb now is nourished through the agency of these newly formed roots and it develops into a tree through the process of adaptation. This is an example of speedy adaptation to meet a changed environment. Every form of animal life must adapt itself to changes in food, climate, protection against enemies and other surroundings in order to continue in the "struggle for existence." The curly hair of the African negro furnished an example of adaptation for the protection of the brain against the excessive heat of the tropical regions of Africa. The excessive heat in these regions will cause sun stroke to many white persons even with their heads protected while the curly hair of the negro forms air pockets that absorb the sun's heat

thus making him immune to sun stroke. There have been many thousands of plant and animal forms that have failed to adapt themselves to changing conditions, and, as a consequence, they have been cast into the discard and are now extinct.

The trilobites were the ancestors of the crabs and the crabs were among the first to adapt themselves to life on land. The trilobites had developed eyes, a shell or armour covering the upper or exposed parts of the three lobes and their heads, and a method of transportation. Legs with hinged joints had come into being and such are now classified as insects. They were at first water creatures and out of these, the land insects were developed through adaptation to the conditions surrounding them. Sea crabs became land crabs, sea scorpions became land scorpions and in like manner thousands of sea animals and insects left the sea and adapted themselves to the conditions on land. But many of these as we shall later see when we shall reach the age of the mammal type of land animals forsook the land after millions of years and returned again to life in the sea. Swifter progress was now being made. Many of the land insects were developing wings. These were not true wings but were wings with a hinged joint. Among the greatest of these were the huge dragon flies with a wing spread of thirty inches and a compound eye and the giant cock roaches two or three feet in length.

The law of Nature is that animals shall live on one another, either directly or indirectly. In their "struggle for existence" Nature began far down the scale in both plant and animal life to construct agencies of protection around

its creatures as a means of defense against their enemies. Some of the insects and animals developed spines and quills, scales and stings. The crabs developed a protecting armour and the mollusks, oysters and shellfish of all kinds developed a process of extracting lime from the water and forming it into shells of beautiful designs and coloring as a protective home in which to live. The more active insects developed speed of legs and wings with which they might escape their enemies. The law of the sea as well as the law of the jungle is that the most cunning as well as the swiftest and most powerful shall survive. In order to outwit their stronger and more powerful enemies, it was necessary that a sensitive system of body communication be established and that this system be centered in a directing brain. From this brain messages must be sent to all the various parts of the body and in turn all the various organs of the body must be guided in their functions by the brain.

It was destined that the nerve centers were to play the greatest part in evolutionary growth. Throughout all of life's history covering a period of many millions of years this process of developing a nerve system had been going on. A central nerve center, first a knot or ganglion, had developed into a rudimentary brain. Its importance in the scheme of life demanded of it greater duties and the highest degree of protection. It was also necessary that the center of this nerve system be connected with a conductor reaching to all parts of the animal organism and that this conductor be equally protected against injury in order to properly perform its functions. This led to what is commonly called the "next great step" in evolutionary progress—that of pass-

ing from the invertebrate to the vertebrate type of animals. However, this is a misnomer as there are no abrupt steps in evolutionary growth, but instead, there are changes so gradual that they blend like the colors of the rainbow. But it was this change from the invertebrate to the vertebrate type that led to the more rapid development in the forms of higher life. It must be remembered that nearly three-fourths of all of life's history had passed before the animals of this period came into being. But before passing on to the life of the vertebrate animals, it is of interest to note the forms of life that make up the connecting link between the invertebrates and the vertebrate animals.

Many of the oldest classes of animals known because of some basic defect in their structure or their habits of life have gone into a "dead end" or "blind alley" road and there remained in practically the same form for millions of years content to live without development. Many thousands of classes have lived their lives without adaptation and have passed from the scene of struggle. Others have degenerated from a higher form to a lower form and have lost the advancement that had been made by their ancestors. Included in the classes that have failed to make progress in their advancement are the star fishes, mollusks, cephalopods, sea urchins and many others. The parasitic animals belong to this class for no animal, regardless of how far down the scale of life or up the scale of life, can live on the labors of another and, at the same time keep abreast with the school, flock, pack, herd or crowd. Many of the unprogressive types have constructed walls about them over which they cannot climb or built a load of lime around their bodies that

they cannot lift or cast off. But above these, there is a main line that forms the tree of advancing life.

The principal classes of this main line are the worms, arthropods, ostracoderms, fishes, amphibia, reptiles and mammals. It is through this chain that Organic Evolution has developed the tree of life by progressive changes from the lowest to the highest forms. Unlike the other non-progressive groups, the bodies of the classes above named began to take on a general form and a similar internal structure. They were divided into separate segments for flexibility. They became straighter in order to enable them to travel faster. As a result of this form, their nervous systems, digestive systems and circulation systems all extended in the same direction paralleling each other. Many of the other organs of the bodies of the various classes were compound in their nature but by adaptations to the most economical and practical uses, most of these became paired, two eyes, two ears, two lungs, two nasal passages, two gills, two kidneys, two fins, two legs, two wings, etc. With this arrangement, these classes of animals were better prepared to solve changing conditions of life and to make adjustments to meet changing environments. Many of the segments of which their bodies were composed were combined and enlarged and many were reduced to meet the necessary conditions of adaptive growth and to eliminate a duplication of effort. All the organs of all bodies have been placed in the most advantageous positions, by adaptations, to perform their particular functions with the greatest economy of effort and in coördination with all other organs.

The nerve conductors of the lower forms gradually wove themselves into a central string commonly known as the notochord. Around this sensitive organ a cartilaginous substance was formed which was the beginning of the backbone. The many jointed segments of the lower forms, through adaptation became the skull and vertebrate of the higher forms which were to follow. As necessity for a larger brain developed, the segments which formed a part of the invertebrate forms were pushed out and formed a mould which surrounded as a protective covering the growing brain. The cartilaginous substance as a means of greater protection through the course of ages became hardened into bone.

The gradation between the invertebrate and the vertebrate animals, is the most obscure page in the history of life but there was a class of animals, now long extinct, that connect the two great divisions. Scientists call them ostracoderms and like the animals connecting one class with a higher class, they possess some of the characteristics of both. They were developing cartilage into bone. The first bone was formed around the notochord which was the main channel of sensation and this was formed in segments corresponding with the segments of the body. As the vertebrate were gradually formed, the protective armour that formed a shield for the body was changed into more flexible forms to correspond to the flexible vertebrate. This armour became the scales of the fishes, the feathers of the birds and the skin of the mammals.

These ostracoderms were long and joined and had two or three sets of jaws. They were a higher form than the

sea scorpions and yet a lower form than the true fishes that were to follow. They were, doubtless, the immediate ancestors of the lampreys and ganoids, the most primitive of the true fishes. Their fossil remains are among the rarest known as only a few entire forms have been discovered, but sufficient fragmentary remains have been found to give them their important place in the tree of life.

CHAPTER XVII.

Complex Life—The Invertebrates.

MORE than half way up the tree of life, measured in terms of geologic time, vertebrate life came into being. This upper part of the tree of animal life consists of five classes, namely—Fishes, Amphibia, Reptiles, Birds and Mammals. All these classes have the same basic structure in their organization. The more important characteristics which cause them to be grouped under one heading are a jointed vertebral column composed of cartilage or bone which acts as a protection and support of the nervous system. From now on up the scale of life, the nerve sensations play the major part in animal progress. To the backbone there are usually attached pairs of ribs, two pairs of limbs, which may be either fins, legs or wings, and in the front, this backbone terminates in a more or less highly developed skull as a protective covering for the directing brain. In the body cavity protected by the ribs, a digestive system is located which turns the energy force of food into body energy. A highly organized circulatory system is also enclosed within the body cavity which carries the blood to all parts of the body.

The function of breathing in the aquatic animals is carried on by means of gills and in the air breathing animals by means of lungs. The nervous system centering in the brain and through the spinal cord controls the activities of

the entire body. The sense organs that have developed a high degree of acuteness now render life much more complex than it has been before.

All vertebrates are bilaterally symmetrical with their body parts basically the same but modified to function best in the environment with which they are surrounded. The fins of the fishes, the legs of the animals and the wings of the birds are simply locomotor appendages developed to perform their functions in the most advantageous manner. The most important cranial nerves and eye muscles of a fish, frog, reptile or bird have their corresponding parts in man and the other mammals.

The forces of Nature are immutable—they always were and always will be the same. The vibrations of light, sound, heat, the forces of gravitation, adhesion, cohesion, molecular and atomic were the same at the time of the first life spark as they are today. It was the function of Evolution to develop the special sense organs of animal life so that the agencies of Nature could be made use of in the advancement of the animal kingdom.

Evolution's foot prints may be traced with convincing certainty, with the chief steps in the modification of all of their body changes from the fishes up to man. The development of the highly organized special senses and the locomotor appendages made it possible for nearly all vertebrate animals to transport their bodies to new environments in a shorter time, to reach new food supplies and to protect themselves against their enemies. Different environments called for different adaptations and as a consequence, different forms. From the first true fishes, to the present time

these adaptations have developed about ten thousand kinds of bony fishes. These are divided into approximately two hundred different families and these may be grouped into eighteen or twenty orders. These adaptations and changes in forms are found in a proportionate degree in all the other classes of the vertebrate group. But fishes are those vertebrate creatures which spend the whole of their life in water and which do not develop legs, fingers or toes. There was a call from the sea to the land but fins and gills were useless on the land because they are adapted for use in the water. To prepare for the environment on land, it was necessary for the fishes that desired to change their environment from sea to land, to develop lungs with which to breathe the air, limbs and toes with which to crawl, walk and climb. One group of fish began to develop lungs, whether from desire or necessity we do not know, but some of their lineal descendants are still found in the rivers of Australia, Africa and South America. They breathe like other fishes during the wet seasons and then breathe with their lungs when the rivers dry up. They are the ancestors of the next general class of vertebrates—the Amphibia. But since fins are useless as a means of locomotion on land, they then began to develop legs. Nature aids the efforts of her creatures if these efforts are directed in the right direction. When gills were of no further use, she developed a spongy lung capable of extracting oxygen from the air. Where fins could be no longer used, she developed legs as a means of locomotion. As the fish were flopping about in the shallow water, the fins became less useful and the necessity for legs increased. If we wear a tight fitting shoe

where some part of the foot is subjected to constant rubbing, Nature thickens the skin of the disturbed part until it becomes thicker and calloused as a means of resisting the friction and as a protection to the more tender parts.

In like or similar manner, little appendages began to form on the bodies of the fishes. These developed with use and as their constant use continued, Nature developed therein bones, supporting muscles and all that goes to make a useful leg. Scales were cast off and a flexible skin then covered the entire body. With the development of legs and other body changes, the new animal could then hop or crawl on land. Thus, through adaptations, another great step in the chain of life was taken and another class, that of the amphibia, came into being.

Nature does not abandon the work in which she has been engaged for millions of years in a single day. While the new class of animals took on new habits of life on the land, they still clung to many of the habits of their aquatic ancestors. Amphibians, even to the present time, are essentially fishes in their development in early life. The amphibians and in fact every animal that is hatched from an egg repeat the history of their ancestral development. Tadpoles are hatched in the water. When they are first hatched, they are blind and mouthless and have neither ears, nose nor gills. In the eggs from which they have come, they have repeated all the life processes that have preceded them. But soon after hatching, they develop a mouth, eyes, ears, gills, nose and a horny jaw, but they are, as yet, essentially fishes. They are not yet ready for life on land but within a few weeks hind limbs begin to develop beneath the skin and, like

a baby cutting its teeth, they finally protrude. At a little later date fore limbs develop in the same manner. The tail which was used in swimming is now of no further use and is therefore cast off. These limbs now serve as arms and legs upon which are attached fingers and toes. Their lives will be spent in and near the water and, because of this, webs of skin are attached between the toes to aid them in swimming. They are now able to swim, crawl and hop. When approached upon the bank of a stream or pond, they revert to their primitive instincts by jumping into the water as a means of protection.

If we shall notice a fresh water stream or pond in the springtime, we can see the very processes of Evolution working before us. Fastened in strings upon the water weeds or marshy grass may be found the eggs of frogs in the process of incubating. In this act they are repeating all the former life processes. From day to day we can see the metamorphosis of the tadpole taking place—eyes and ears developing, gills and tail disappearing, mouth opening, legs protruding, the notochord changing to a jointed back-bone, bones forming in the limbs and a skull forming as a protection to the brain. They change from gills to lungs, and from a vegetable to an animal diet. All this is just repeating the life processes of millions of years in a few week's time.

Different environments have brought about different habits among the various amphibia. Some have abandoned the water as a place for depositing their eggs. Some of the salamanders bring forth their young alive. In a few species of tree toads that have abandoned the water, the eggs are

stored in a pouch on the back of the parent until the early stages of growth are completed while in one of the South American toads, the eggs are placed by the male on the back of the female where they sink in cavities of the skin. Here, true to their ancestral heredity, they pass through the tadpole metamorphosis and emerge with the form of the adult in a similar manner to that of the marsupialia.

It is a noteworthy fact that many of the frogs, like many of the fishes are cannibals and eat their own offspring. The toads live chiefly on insects, and insect larvæ while the principal food of the frogs consists of water insects, small fishes, snails, bugs, and such other small life as live in marshy places. Another noteworthy fact is the power some of this group possess to change their color to correspond to the objects about them as a means of protection against their enemies.

In some of the tree toads this chameleonic characteristic is so highly developed that they have the power of changing their color with each change of position. Others have gorgeous colors, perhaps, as danger signals, which give warnings to their enemies to beware of the poison which they possess while in others the warty protuberances of their skin emit a milky, bitter secretion that protects them against their enemies.

The amphibians, the same as the fishes, are cold-blooded; that is they do not possess the power of regulating the body temperature and as a consequence, their movements are noticeably reduced when the temperature surrounding their bodies is lowered. The heart of the fishes has only two cavities, an auricle and a ventricle. But when

the amphibians crawled out on land and began to breathe their oxygen from the air, a new adaptation was necessary and Evolution stepped in and created a new or third heart chamber which gave to them greater capacity for purifying the blood and becoming more active in their new environment. The circulatory system of the fishes is much more complex than that of the invertebrate animals and the circulatory system of the amphibians is much more complex than that of the fishes. In like manner all the other body organs were changed to meet the new environment surrounding them.

The amphibians were the first to leave the water and to take up their abode on land. Here they literally left their "footprints on the sands of time." Their tracks are found imbedded in the sandstones as early as the Devonian period. They became armored giants in the Carboniferous period attaining a height and length of several feet. The early amphibians lived in a period of world-wide uniformity of climate with a warm moist atmosphere with less light and heat coming from the sun. At this time the air was perhaps, not yet sufficiently purified for the life of man but Evolution was preparing the way for the higher life that was to follow.

CHAPTER XVIII.

The Reptiles.

THE next class or division in the tree of animal life is that of the reptiles. To a casual observer it may seem that the reptiles having the general shape of body and to a certain extent a similar internal plan are not materially different from that of the amphibians. But notwithstanding external resemblance, they present to those concerned with Evolution's facts a distinct line of demarcation. They were the first true air-breathing land animals and they dominated the earth for millions of years. They developed the first egg with a shell and hatched their young on land without returning to the sea. They pass through the fish-like stages of ancestral development within the shell but they breathe by lungs only after they are hatched. In these the circulatory system was undergoing great changes to meet the changed conditions on land and the heart had developed into four chambers. The size of the brain had increased and nervous sensation had become more highly developed.

During the period of more than thirty million years covering the Age of Reptiles, hundreds of bird-like, fish-like, animal-like forms were developed. They became, through adaptation, crawlers, climbers, runners, flyers and swimmers. They were both carnivorous and herbivorous. They developed into the most gigantic forms the world has ever

known—giant lizards, turtles, crocodiles, serpents, dinosaurs, pterosaurs and many other "saurs."

This was an age of physical combat among the giants of all ages in their efforts to survive. The weaker were conquered by the stronger and in turn the stronger were conquered by the cunning of the weaker. Each group played its part in the scheme of life and passed from the stage of animal struggle yet leaving certain heritages for the future life that was to come. Out of all the vast numbers of these that struggled for millions of years for survival, only four orders remain and these representatives are the snakes, lizards, alligators and crocodiles. It has been said that during this vast period of time, Nature made many experiments and many mistakes. Adaptations that fit conditions today could not fit conditions a hundred million years ago for animal life has no part in geologic changes or changes in climatic conditions except adaptations to meet these changes.

It is the purpose of this outline to show, not all, but only a few of the successive steps which animal life has taken in passing from the lower to the higher forms. What special progress has this class made over the heritage of the past that will be a heritage for all life that is to follow? To enumerate some of the changes in progressive development we find that, after emerging from the egg, the gill slits are gone and the animals of this class breathe by lungs; that the first evidence of parental protection for the offspring begin to appear; that the eggs are larger and fewer in number and that they have a hard or leathery shell; that the eggs are deposited in protective nests or sand best suited to their

proper incubation; that the heart now has four chambers instead of three as in the preceding class; that the special senses are more highly organized; that the size of the brain has increased and bodily activities have been greatly extended; that life on land was completely emancipated from its former life in the sea, the primal home of all life; that leathery wings were developed by which animal bodies were first transported through the air; that the digestive system was changed to meet food conditions on land; that many forms of body armor and body weapons were developed to aid them in their struggle for survival. All of these changes were improvements over the body functions of the amphibians and not only placed life on a higher scale, but prepared it for the next great step of animal progress.

It was during this period that the most gigantic life forms were developed. This was, indeed, an age of monsters. Many species of dinosaurs, both carnivorous and herbivorous came into being. These were species of lizards—some giants, some pigmies—some the size of a chicken and some eighty feet long and standing nearly thirty feet high. There were huge flying crocodiles and flying serpents. Some of the giant, clumsy vegetarians attempted to grow a brain in their tails. Some had massive hind legs and massive tails which were used as a tripod when the lizard reared up to feast upon the tops of the palms and ferns. These vegetarians developed the thickest armor and the flesh eaters developed the biggest and the sharpest teeth.

The flying crocodiles were insect eaters. As these developed their forelegs into wings and took to the air in quest of their favorite food, we find the forces of Evolution,

Nature's way, again changing their body forms to meet their new environment. They shed and cast away their teeth. Their long and heavy tails disappeared. Their bodies developed a shape that would offer the least resistance to the air and their bones became thinner, lighter and stronger. Their plate-like armor was cast off because their swiftness of motion enabled them to escape their enemies and this protective armor was no longer needed. Their wings were bat-like and in some, had a wing spread of twenty feet. The change from land to air was no quick and sudden change but on the other hand, it was a change covering millions of years. It is generally conceded that like the flying squirrel, it was at first a crawler or climber to the palm and fern tops after its favorite food and as necessity arose, folds of skin were flattened out to resist the air and, perhaps, lessen the fall. Then the hind legs were reduced and the fore legs developed into wings. Nature was laying the foundation preparing the way for a new order of flying creatures—the birds.

We have seen that the heart of the fishes was two-chambered, the amphibians three-chambered, while that of the reptiles was four-chambered. But the circulatory system was not yet perfected to a point where the body temperature could be controlled and the blood purified as in the next class—the mammals. The reptiles were still cold-blooded. Many of these reptiles, after living for millions of years on land and adapting themselves to its uses, forsook the land and returned again to the sea. Nature began all over again to adapt their bodies to the environment of the sea. Here their legs were developed into flappers and they became the

Ichthyosaurus or fish lizard. Another group left the land for the sea and became the great snake lizards—the Mososaurus. Great battles daily raged among these monsters on both land and in the sea. They were struggling for supremacy in the kingdom of life and in many cases their kind is blotted out for reasons beyond their control. It may have been because their food supply gave out or because the animals upon which they were living changed their habits or were exterminated by some pestilence. It may have been because of changing climatic conditions or geological upthrusts of the surface of the earth. At any rate, they lived, moved and had their being at a time and under conditions far different than those of today. Their bodies in countless numbers, together with the fishes of the ancient seas, were covered by earth movements, by waves, mud and sand and their struggles in life preserved to oil the wheels of industry when Cultural Evolution found a way to reach and use the oils and gases which they had accumulated by their labors when the earth was young. Little does the average person think as he drives into a filling station and asks that the crank case of his motor be filled with oil and his tank with gasoline, that he is using the substance of power gathered and preserved by these fishes and reptile millions of years ago. Everything in Nature has a purpose and nothing is wasted. The sunshine and moisture brought forth the palms and ferns and sea weeds that furnished food for the insects, fishes, amphibians and reptiles and they in turn changed these foods into the oils and gases of their bodies, the power of which transport us in our automobiles and in aeroplanes from place to place. We have seen that the first

flying animal was the wide-winged flying crocodile and that these were insect eaters. In principle, the modern aeroplane is patterned after the flying crocodile whose muscular power was furnished by the insects it ate and the source of the power that propels and lubricates the parts of the mechanical machine is the same as the flying crocodile used millions of years ago. Every plant that has been swayed by the wind or ocean waves, every animal that has squirmed, wriggled, swam, crawled, walked or flown has played its part in the advancement of our civilization. All things are a part of the Creative Plan. It was so in the beginning, is now and ever will be. It is given to man to search out the relationship of every part and apply it to the entire Plan. In no other way can this be done except through the processes of Evolution. We have seen that out of all the hundreds of forms of animal life that were developed during the "Age of Reptiles," only four of these orders still survive. One of these orders is represented by the snake family. Since the snake developed form and habits that have made it possible for it to survive throughout the ages while many of its kindred have passed from existence, it is well to learn something of its habits and history. The snake's ancestors were forelegged animals of the lizard type. Somewhere down the tree of life, there came a condition that caused it to change its habits and its form. It may have been a change in its food supply or it may have been brought about by some enemy that preyed upon this particular family, but it gained an advantage by casting off its legs and becoming a wriggler. The snake, more than any other animate creature possesses properties of mystery. Without feet or claws, fins, legs or

wings, it travels on land and on water without noise or warning. It climbs a smooth barked tree or pole, thus apparently defying the force of gravitation. Its movements are graceful and weird and its strikes its foe with the speed of an arrow, winds its body about its prey and crushes the breath of life from its victim. Many of this family have developed poison fangs which all other animal life have learned to shun. Because of the hinged and movable joints of its jaw bones, it is enabled to swallow a victim three times the size of its own neck. It sheds its skin and comes forth renewed and rejuvenated. The glow and piercing of its eye has the power of producing a paralyzing charm in its intended victim. Because of these mysterious qualities, the highest forms to which animal life has attained—that of man in a savage state, have worshipped the snake as possessing powers of divinity. There is no mythology or ancient sculpture in which the serpent does not bear a part. In the early ages of man, serpent worship or Ophiolatry was universal. The greatest prehistoric monuments of the savage races were dedicated to the snake—the "stranger in the grass." Not only do we find proof of its effect upon the minds of the early primitive savage races in the form of serpent mounds made mostly of earth but we find the same evidence in the lowest strata of civilization in Egypt, Assyria, India and many of the other ancient nations from which our civilization has sprung.

In "Rivers of Life; or Sources and Streams of the Faith of Men in all Lands" published in London, 1874, by Professor J. E. R. Forlong, and also in Bryant's "Ancient Mythology," published in London, 1807, may be found what is per-

haps the most exhaustive study of serpent worship that has been printed. Moses, in the name of God, forbade the Israelites from inquiring about the dæmons, Ob and Ideone, serpent gods, which shows that Ophiolatry had gained a foothold on the primitive mind before the Bible was written.

When Nature takes a forward step and develops a new and higher form of life, this new form is not fully developed but it must start at the beginning and crawl before it walks. It is surrounded by many enemies and in order to survive, it must outclimb, outrun or outwit these enemies. Some of the reptiles had begun to develop and hatch their eggs within their bodies. Nature had been at work in many ways—adding some improvement here and casting off the useless in other places. Preparations had been made for another order whose advance guards had begun to appear. The reptiles had gone as far as they could go and many of them were being cast into the discard because of changing conditions. Up to this time, there was little of parental care or altruism in the world.

Nature always leaves sufficient vestigial organs in her creatures to show us how Evolution works in building from a lower to a higher order. We have seen that the reptiles had four-chambered hearts but these were incomplete. Even with the four incomplete chambers, the reptiles had no power of controlling the temperature of their blood. Like all cold-blooded animals, they had no power of adaptation along this line. But sometime toward the end of their 30,000,000 year reign, some reptile developed a true heart with two auricles and two ventricles capable of separating the pure and revitalized blood from the impure. They developed

pores in their skin to help regulate the body temperature, and changed their scales to hair and feathers. They began to hatch their eggs within their bodies and to give birth to their offspring. It must not be understood that the contemporaneous classes then living copied these new body functions and adapted them to their present use—far from this. These new developments furnished additional opportunities for adaptation but all the new species that follow have sprung from the parents that made the change. The other groups have stayed in their own blind alley and failed to progress.

The foundation structure for two new general classes—that of the birds and mammals was now prepared.

The birds are not directly descended from the leather winged flying crocodiles, for their race is now extinct; but instead, they have developed from a type of running or jumping lizard that used only its hind legs in running and chasing its food. They ran semi-upright using their forelimbs in a flapping motion until they developed into wings. Their scales became elongated and split up and developed into air chambered feathers as an adaptation to their use. In the same or similar manner, all their other bodily functions have developed to meet the conditions of their environment.

CHAPTER XIX.

Coöperation of Plant Life.

DURING all the vast period of time since the first "Life Spark" came into being, there has been a community of interest between all plant and animal life. Their progressive struggles have been constant and contemporaneous. They have marched hand in hand from the lowest to the highest forms—each giving, each receiving from the other. Without this reciprocal arrangement, neither could long survive. The algæ is paired with the amœba, the lowest forms of sea weeds with the lowest forms of worms and protozoa, the mosses and lichens with the trilobites and crinoids, the early ferns with the flying insects and scorpions and so on throughout the entire scale of life.

The vegetable kingdom possesses powers which the animal kingdom does not have. The plants extract oxygen from the air and mineral foods from the air and soil. They have the power of forming protoplasm and of storing the sun's energy in usable form. They provide the food such as nuts, roots, fruits, grains and grasses upon which all animal life must depend, while animal life in turn, through its bacteria, worms, etc., recreates the dead plants into plant food. In addition to this, the higher forms of animal life become distributors, transporters, and fertilizers of plants and seeds.

As it required millions of years for the animals to reach the stage of a backbone, so it required millions of years for

the plants to reach the stage of a true leaf and other millions of years for the plants to reach the stage of a true flower. Throughout all of life there has been a perfect balancing of equations in the forms of both plant and animal life. These forms have gone through thousands of changes casting off the useless and holding on to the useful and adapting them to a higher purpose.

The lowest forms of plant life like the lowest forms of animal life absorbed their nourishment through their cell walls while floating in or on the water. When one of these threw out an arm to get more food, that was action, change, progress. Nature demands action and change and for these she offers as a reward—development and progress. The mosses that had developed into tree like ferns were still reproducing themselves by spores. Life had reached a medieval period in both the plant and animal kingdoms. It was necessary that another forward step be taken and this was brought about by the development of the leaf so arranged that it could drink in and store away its energy from the sun. In order to develop strength, it must have sunshine. We have all seen a potato sending out its long, tender white sprouts in a dark, damp cellar. It is simply reaching out and searching for a ray of sunlight from which it may draw its chlorophyll which gives to it both color and strength. The roots are reaching out for water and plant food from the soil while the leaves are drinking in energy from the sun, the function of each is to build the main body and fit it for its struggle in life. It does not possess the power of locomotion and must of necessity adapt itself to its environment. If by chance, its environment is cast in a favorable spot where

fertile soil, moisture, sunshine and favorable climatic conditions are found, it will develop into a perfect specimen of its species while if these favorable conditions, or any of them be wanting, the plant's struggle become greater and its development dwarfed. Proper environment, therefore, is just as important in the development of plant life as it is in the development of animal life.

In the sacred scriptures we have the admonition, "Consider the lilies of the field, how they grow; they toil not, neither do they spin, yet I say unto you that even Solomon in all his glory was not arrayed like one of these." If we shall heed this admonition and consider the make-up, the construction of these lilies, we shall find that the flower is the immediate agent in the production of the seed which contains the embryo which resurrects and brings forth a new life. What may be said of the lily may also be said of all the flowering plants. The seed embryo is the end toward which the whole structure is designed. The organization of the flower forms one of the most interesting studies in Nature. Its parts are many and these parts are each performing their separate functions. They vary in form to an almost infinite degree but with one central purpose of reproducing their kind and playing their part in the plan of evolutionary growth. The juices of the rushes, mosses and ferns furnished the lower animals food which enabled them to develop into higher types and as these higher types developed, it was necessary that the plant types take the lead in order that the advancement of the animal types should be unretarded.

The pistils, the female part of the flower which bear the seeds, occupy the center of the flower. These are sur-

rounded by the stamens, the male part of the flower which fertilizes the seeds. Nature had discovered that "in breeding" produces degeneration and that "cross breeding" produces new varieties and progress. Since the plants do not have the power of locomotion and since both male and female sex organs are located in the flower, Nature arranged a reciprocal plan between the flower and insects that would bring about "cross breeding" thus insuring new varieties and stronger offspring. This arrangement forms one of the most interesting pages in Nature study. The stamens produce the pollen dust that fertilizes the seeds. In some plants the wind will carry this pollen dust to a neighboring plant but not in all varieties. Insects carry this pollen dust on their bills, feet, legs and wings. In some of them, it is carried in baskets on their legs. But going from plant to plant calls for work which must be rewarded. The flowers have developed both color and fragrance to attract the insects and then as a reward, the flowers have developed little cups of nectar-honey which is a delicious food for all honey loving insects. In gathering this honey which surrounds the pistils of the flower, the pollen dust from the nearby stamens is brushed off and attaches to the bill, feet, wings, legs and baskets of the insects and is then carried to some neighboring plant and brushed off on its pistils. Thus the plan of cross breeding is carried on among the plants.

But this reciprocal agreement is not always carried out in good faith and conscience because some of the plants have turned criminal, have become flesh eaters, and use their honey as a bait for the trap into which they can entice their prey and then fasten them up and devour them. Others are par-

ticularly partial to certain kinds of insects. Experience has taught them that they receive better returns in their cross breeding from some insects than they do from others and as a reward for the better service, they protect their honey cups so as to give advantage to the favored class. The plants that depend on the aid of insects for cross fertilization develop the most beautiful flowers, the greatest amount of nectar and the sweetest fragrance while the ones that depend on the wind to bring about their cross fertilization, make no effort to develop these unnecessary functions.

According to the evolutionary plan, from the beginning of life, it was ordained that there should be change and growth and that each change should be for the better and that the ultimate end should be perfection of the type in relation to the creative whole. Plant intelligence in making changes for the better and in adaptation to surroundings is another interesting demonstration of the coöperation of all life in order to reach the ultimate end—perfection. It is not given to our finite minds to understand the cunning of plant intelligence nor the secret processes by which the marvelous changes are wrought. When we realize that the beautiful and snow white water lily is only a changed form of the mud and slime from which it grows, and that the life germ of each seed possesses all the plant's traditions of the past and its potential powers of future changes and growth to meet the conditions of a changing environment, we must conclude that no other plan could have been devised to meet these changing conditions except that of Evolution.

It must not be understood that the lives of the plants have been floating on "flowery beds of ease" for such is not

the case. On the other hand, there have been and now are just as fierce struggles going on in the vegetable kingdom as there are in the animal kingdom so far as a survival of the fittest is concerned. The law of the jungle is no less merciful than the contest that is constantly going on for advantage and supremacy in plant life. The roots of all plants are pushing out, moving and struggling for moisture and the life giving substances which they are gathering from the soil to pass on to the parent body, while, at the same time, the leaves are drinking in body building elements from the air and sun. If these root fingers come in contact with the root fingers of some rival plant whose quest is for the same life giving substances, the root fingers are entwined in a stranglehold of death for the weaker of the two. While these struggles for mastery are going on unseen beneath the soil, the upper branches are pushing, crowding and reaching higher for the other life giving substances from the air and sunshine. The contest is not always awarded to the one possessing the greatest strength of body, but instead, the cunning intelligence of the weaker plant, such as the creeping vines, sometimes overcomes the superior strength of the stronger rival. Thus the endless struggle for the survival of the fittest plant has gone on from the beginning and it will continue to do so throughout the future centuries.

The coöperative effort of plant life has furnished food, clothing and shelter for the animal kingdom without which no animal life could exist. Just as animal life has advanced in gradual and successive steps through long periods of time from the amœba to man, so has plant life developed from the algæ to mosses, from mosses to ferns, from ferns to

shrubs and plants and from plants and shrubs to trees. They have yielded fruits, nuts, roots, grains and grasses as foods for animal life, their fibers for nests and clothing and their bodies for shelter and protection. During this period of development many thousands of changes have taken place. Many have fallen by the wayside and perished; many have gone into blind alleys and failed to progress, while others have been content to remain in the same condition as they were at the dawn of creation.

The changes that have taken place in the forms and varieties of plant life have been brought about through adaptation to fit surrounding conditions but just what force or condition or combination of forces and conditions are required by unaided Nature to produce a new variety of fruit, grain, grass or vegetable is not known. Unaided Nature has been forming these throughout the ages. But when Cultural Evolution came to the aid of Nature, all matter of useful plant life has been improved by selecting the strongest seeds from the strongest parents, by destroying plant enemies, by cultivating and fertilizing the soil, by cross breeding, by budding, grafting and pruning, and through these processes new varieties have been created. Through the coöperation of plant life with animal life and through the aids of Cultural Evolution to plant life, the vegetable kingdom and the animal kingdom have climbed upward to higher plains of existence. If we shall judge the future by the past, it would be a hazardous guess to predict what may be possible in the way of future development. The statement of the Grecian philosopher—"Most men are fools, Alcebia-

des, because they fail to discover in the germ or even in the growing stalk the vast possibilities of development" is more pregnant with truth today than it was when uttered more than 2,000 years ago.

CHAPTER XX.

The Birds.

BEFORE taking up a study of the last and greatest class in the tree of animal life, the mammals, it is instructive to note the cumulative evidence presented by the birds in a story of Evolution. In an outline such as this volume is intended to be, they shall only be considered in their relation to adaptation and environment; of the part they play in the Plan of Creation and of their importance to all life, both plant and animal. Birds are the warm blooded near relatives of the reptiles. Their toothed, reptile-like ancestors began to change their scales into feathers and fossil evidence has been found in that of the Archæopteryx which was apparently half bird and half lizard and having a tail as long as the body with two long feathers growing from each vertebra. This proves their ancestry. We have seen that their forelimbs have been developed into wings by their constant flapping while chasing their food or escaping from their enemies. In these fossil birds the wings were not as yet fully developed and the claws on the fingers were distinct in what is now the wing tip of all true birds.

These were the connecting link intermediate between reptiles and birds. These ancestors of the birds developed a four-chambered heart that started their development along a branch contemporaneous with but different from the branch that has been followed by the mammals. The food supply

of both the birds and mammals is determined by the environment surrounding them and all the many thousands of different forms into which they have developed is directly traceable to their food supply. The most distinguishing mark of birds above all other creatures is that of feathers which are designed for both strength and lightness and fits them for the power of flight. Their feet and toes are still covered in a modified form with the ancestral scales of the lizard. Their internal structure has been modified to meet modifications of their bodily forms. In the far distant past, they developed their upper and lower jaws into hornlike bills or beaks. These have a great variety of forms depending on the kind of food upon which they live. The necks are either long, short or of medium lengths depending entirely upon their food and environment. The forelimbs have developed into wings with the same number of bones as are found in the other vertebrates. The hand of their ancestors has been developed into a flattened bone indicating the joining of the several bones of the hand.

Their circulatory system is developd to a high degree, which together with their air chambered covering of feathers, gives to them an even body temperature ranging from 102° to 100° Fahrenheit. Because of their pure blood and high body temperature, they are unusually active in their habits and develop a great amount of endurance. In some species during their period of rapid growth, the young will consume food in quantities equal to three times their own weight in a single day.

Their ancestral teeth were cast off before the seeds and grain had developed into their present hardness. To over-

come the necessity of grinding teeth, they developed their stomachs into muscular gizzards and among the grain and seed eaters, these gizzards are aided in their cutting and grinding by sand and pebbles. They have thus developed a mill within themselves instead of reverting to their ancestral teeth. In those species using food that requires the greatest amount of stomach work before it can be digested, their esophagus is dilated into a crop in which the food is softened before passing on to the gizzard for grinding.

The waders present an interesting study. They are aquatic in their habits but instead of swimming and diving for their food, they seek and obtain their food by wading along the shores of the creeks, rivers, ponds, lakes and oceans. Because of this habit, they are commonly called "shore birds" or "waders." Nature has adapted them for such an existence by giving to them long legs, long necks and bills that are longer than their heads. The night herons that belong to this class are uncanny in their methods of fishing. They stand in the reeds along the shallow shores sometimes for hours waiting for their prey. The smaller fish are picked up and swallowed whole while the larger ones, some weighing as much as four pounds, are pierced to the vertebra by the sharp bill and paralyzed, and then cut into pieces small enough to be swallowed.

No place in the entire scheme of life are the social relations of plants and animals to one another more clearly demonstrated than in the part played in the ecology of Nature by the birds. Each of the many species of birds are playing their part in the Plan of Creation. The vultures and scavengers are ridding the earth of its putrefying dead. The song-

sters are filling the world with joy and gladness. The insect eaters, the most important of all groups, make the existence of plant and animal life on earth possible and, without their aid, no life can long exist. Each plant and animal has an enemy and some of them have many. The parasites and saprophytes are those that live on the work of others. The statement that "Every louse has a louse" is partly literal truth. But besides the parasites and saprophytes, enemies of all life, there are hundreds of thousands of other forms that are depending on the same foods that man depends on for his existence. These insects produce their offspring by the millions at each hatching, whereas the mammals produce only a few. Many insects develop into adult form within a few hours or days at least, whereas, most mammals require months or years to develop into an adult stage. There must be a means of keeping all life in balance and the birds furnish this balance above all other creatures.

Chester A. Reed, an eminent authority on birds, in his "Bird Guide," says: "The daily consumption of noxious insects in Massachusetts is twenty-one thousand bushels. The estimate is good for about five months in the year. May to September, inclusive: during the remainder of the year the insects, eggs, and larvæ destroyed by our winter, late fall and early spring migrants will be equivalent to nearly half this quantity." It must be remembered that Massachusetts is a small State but multiply this by forty-eight for all the states, multiply the millions of insects contained in a daily ration and then multiply this number by the potential reproductive capacity of each insect and egg destroyed and we have astronomical figures which portray the possibility and probability

of the extermination of all life in a short time if it were not for the balance brought about by the birds. Many of these birds turn these harmful insects into an agency of food for man. As we use the stored energy of dinosaur and flying crocodile in our automobiles, so likewise when we sit down to a chicken or turkey dinner, it is a la bug, worm and grasshopper, our enemies transformed, that we are eating.

Nature has developed the form of each group so that it is best fitted to secure the food it eats with the least effort. Every part of the entire form is adapted for a specific purpose. Every wing, neck, bill, foot, leg and feather are adapted to some particular function. The swimmers are endowed with webfeet, the waders with long legs and long bills, the fish eaters with sharp claws and hooked bills and their colors are usually developed to match the colors of their surroundings as a protection against their enemies. Their ancestral tails have been drawn up into a little knob yet containing an atrophied vertebra which furnishes a flexible tail rudder in their flight. But some of these families found places where food could be secured with little effort. Some of their body organs that had been developed as a matter of necessity in their struggle for food were no longer needed and no longer used. Nature demands action of its creatures and unless action continues, she sets up processes of destruction whose purpose is to destroy the inactive part, for nothing in Nature is constant. All life is either advancing or retreating. Because of a change of food in some of the birds or because of its abundance, they quit the use of wings and as a consequence, Nature began to tear down and

to atrophy these inactive members and this accounts for the birds that have lost the power of flight.

We have seen that the first dim evidences of parental care began to manifest themselves in the fishes. These increased with the amphibians and reptiles; but the true parental instinct came into being when the heart became four-chambered and the blood turned warm. This instinct of caring for, feeding and protecting the helpless offspring was distilled in the first warm blood. It was a part of Evolution's plan. It did not descend like a falling meteor at any particular time or place but instead it came by ages of growth in blended stages. It was the forerunner of the end toward which all life is directed—that of giving life for the life of others.

Thus far all the struggles in life have been physical but now Nature brings forth a manifestation of animal affection that later on in the highest order of creation develops into the cosmic force which we call love. It started in the lower order of birds and mammals and is now revealed in its highest form in man. The mother love in the bird family has developed along the same lines as that of the mammals until they will give, if need be, their lives in order that their offspring may survive.

CHAPTER XXI.

The Mammals.

THE mammals constitute the topmost branch in the tree of animal life. They are all warm blooded, air breathing, terrestrial animals except those that have forsaken the land and returned again to their primordial home—the sea. The whales and seals are representatives of this order and these are still air-breathing, warm-blooded creatures. Their early development takes place inside the body of the mother where most of the processes through which all former life has passed are again repeated. After birth the young are suckled or nourished from the fatty, or milky, secretions of the mammary glands. These secretions have been distilled from the food which the mother takes and from her body tissues and developed into a digestible form containing the greatest amount of nourishment with the least digestive effort for the young offspring.

The overlapping scales of the fishes and reptiles have given way and been changed into a coating of hair with which the bodies of most mammals are generally covered. This serves as a body protection and helps to keep the blood at an optimum temperature.

There are three groups in the mammal class of animals, namely:

1—Those whose body forms are completed within the body of the mother.

2—Those whose body forms are only partially developed within the body of the mother and then removed to a pouch on the underside of the body. In this pouch the young are suckled until they are able to gather their own food. The opossum and kangaroo belong to this order. The opossum is the lowest order of mammals found in the United States.
3—Those that are hatched from an egg and suckled from the breasts of the mother.

This third group is the lowest order of the mammal class. In Australia, "The Land of Inverted Orders," we find living along the rivers an animal which the scientists call Ornithorhynchus, a duck mole, which has the bill of a duck, a body and tail resembling an otter and which lays one egg each year from which its young is hatched. It then suckles its young in the same manner as do the other mammals. The duck moles and a type of ant-eaters are the only mammals which lay eggs.

The first of these groups may be divided into the following orders:

1—Insect Eaters—such as moles and shrews.
2—Toothless Mammals—such as the anteaters, sloths and armadillos.
3—Bats—insect eating flying mammals.
4—Rodents or Gnawers—such as mice, rats, squirrels and porcupines.
5—Hoofed Mammals—One-toed: horse. Two-toed: cow, sheep, etc. Four-toed: hippopotamus. Five-toed: elephant.
6—Mammals that have left the land and returned to the sea; whales, seals, etc.
7—Flesh Eaters—cats, dogs, wolves, etc.
8—Man-like mammals—such as lemurs, monkeys and man.

There are more than 10,000 species of mammals in existence at the present time, the greater number of which belong to the first of the three general groups above mentioned. They are found under all possible conditions of life from the equator to the poles. They have adapted their bodies for habitations on the soil, in the subsoil, in trees, caverns of the earth, in the air, and in both fresh and salt water. Their range and distribution cover all conditions of existence in a variety of adaptations to meet the conditions of the environments surrounding them. They nourish their young upon milk which is produced from the mammary glands of the mother and from which the class is named. These glands are arranged in pairs and in no animal is the number less than two with the number increasing in proportion to the number of young produced at each birth. During the period of gestation, these glands are developed so that their secretions may furnish the proper food for the delicate digestive system of the new born offspring which is unable to digest the food upon which the mother lives. The position of these glands is determined by the convenience they afford to the young offspring so that it may secure its nourishment with the least effort. Nature always devises ways providing for the functioning of body organs with the least effort. In the whales that have forsaken the land and returned again to the sea, prolonged sucking would be a difficult process. Nature has overcome this difficulty by dilating the glands where the mother's milk is collected in a reservoir around which a compressor muscle is developed and the milk is jetted into the mouth of the baby whale without the necessity of a continuous sucking process as is

required in all land mammals. It is the generally accepted belief among scientists that the milk glands are an evolutionary development of the sweat glands.

The transition from reptiles to mammals has covered a period of many millions of years. We learn much from the fossil remains of many species of mammals that were unable to continue in their struggle for existence and we also learn much of the ancestors of many living species whose forms have been changed by evolutionary processes to meet the conditions of changing environments. Nature leaves her footprints which connect the trail of the dim past to the present so that we may know how many of these changes came to be.

One of the most instructive connecting links between reptiles and mammals is found in the living forms of the duckbilled water mole heretofore mentioned and also of the porcupine ant-eater, both of which are found only in Australia and its adjacent islands. These animals are warm-blooded, that is they have developed four chambered hearts. They have developed sweat glands to regulate the body temperature. They have changed their scales into hair and quills, have only one excretory duct for the discharge of the waste matter of the body, suckle their young like other mammals, and yet they still lay eggs which are hatched somewhat in reptile fashion. These are the first steps above the reptiles yet they are the lowest order of the mammal group. Their young are nourished from enlarged pores of the mother's skin which secrete a milky substance. They furnish a living example of Nature's first effort to nourish the young from the mother's milk.

This duckbilled water-mole represents a great advancement over the highest form of reptile life and yet it is the lowest form of the more than 10,000 species of the general class toward which all evolutionary effort has been tending. It has remained in its own blind alley during millions of years because it has failed to change into a higher form. Nature has been experimenting and calling new forces into use.

Other living animal forms show us the next step in evolutionary development. The opossums, kangaroos, certain ant-eaters, the Tasmanian wolf and many small rodents belong to this group. These have passed from the egg-laying state but they have not reached the stage of advancement where their young are born in a completely developed state. They represent the order between hatching and true birth. In this group, the young are partially developed within the body of the mother and when they are born, they are placed in a pouch on the under side of the mother's body, each given a small teat to suck from which they are nourished until they are ready to care for themselves. Even after they leave the pouch, the mother cares for them and teaches them in the art of securing food. The tails of the opossum are without hair and still contain the atrophied scales of their reptile ancestors.

The opossum has developed the very peculiar deceiving habit of feigning death when attacked by an enemy and it is so persistent in this deceit that it will remain apparently lifeless while its bones are being crushed by a dog or other enemy. This same deceiving habit is found among many of the invertebrates. The kangaroos use their powerful hind legs in a hopping process as a means of locomotion and by this method

they are able to travel at a high rate of speed when frightened or pursued. They use their tails as a third leg, which with their hind legs, forms a tripod for the support of the body while standing in much the same manner as did some of the dinosaurs.

Nature has decreed that all life must have an urge—a compulsion before it can leave its low vaulted past and ascend to a higher plane. This ascent is the result of millions of coöperating conditions, so admirably woven together that they form the very essence of life itself for every act of living is so related to the entire plan that it contains within it the principles of progress. The great principles of progress in all living things is work and without work, no progress can be made. The whole economy of Nature produces a compulsion that requires work which in turn creates progress.

Throughout the vast periods of time since life first squirmed in a single cell to the coming of the mammals, the great compulsions of life were those of satisfying hunger, of self-preservation, and of reproducing their kind. Up to this limb in the tree of animal life all life was selfish as a matter of necessity for all the lower forms knew neither home nor care. The first dim dawn of the care of offspring probably appears with some of the fishes. This dawn is brighter with the amphibians and brighter still with the coming of the reptiles but this care for offspring had not ripened into affection until the last great class—the mammals was reached. There had been maternity but no motherhood for there is a vast difference between these terms. Maternity embraces only the physical act of reproducing in kind while that of motherhood embraces all of maternity and in addition

thereto, it embraces love, affection, recognition and care of offspring. When the lower orders produced and still produce offspring by the thousands and millions, there is no time, opportunity or object for mother-love; but when the offspring is reduced to one or a few, mother-love, with all that the term implies is a physical necessity for the perpetuation of the species.

Before the coming of the mammals, there were no inherited traditions of the past experiences of ancestral life; there were only life memories and the use of evolutionary adaptations. But when the complete body was formed within the body of the animal and when the new born offspring took its first nourishment from the parent body, then the female parent became a mother. From the mother's milk each new born creature in the mammal class sucks in all the memories, the instincts, the traditions and experience of the species of which it is a part. In no other way can the inherited tendencies of ancestral experiences be reasonably explained.

Mother-love is the most potent force in the world. It is the foundation upon which all animal experiences and reason are built. It is the force that developed the family life, the herd instinct for mutual protection and brought altruism into being. It is the basis of all social orders from the lowest mammal forms to that of man. With the coming of mother-love, the forces that have led to a higher life were set in rapid motion and these forces have developed brains as an agency for their operation. The evolving forces of Nature through millions of coöperating conditions may now be traced with increasing interest for the reason that all

mammals have so many things in common and because of the similarity of all the animal forms of this class.

The basic structure and the organization of all mammal forms are the same. Their anatomical structure is the same or similar in minute detail. They are all warm blooded, air breathing capable of adapting themselves to changing weather conditions or geographical locations. Except in a few cases, they all have four limbs, the front pair of which may terminate either in hands or feet depending on the uses to which they have been put. Generally speaking, they have the same number of bones in the head and trunk. They all give birth to, suckle and care for their young. They are all developed from a single cell and during their embryonic period, repeat again the processes through which all previous forms have passed. They all see, hear, taste, smell and feel. Many of the higher forms, the ascending groups, are intelligent; they possess the faculty of memory, form ideas and draw conclusions. They play, exhibit anger, hatred, sorrow, love, joy, devotion and affection. These attributes differ in degree only depending on the degree of progress which the respective species has made in the tree of animal life. The forms of the more than 10,000 different species of mammals are determined by the environments that they have adopted or in which their lot has been placed.

If proofs that lead to reasonable conclusions be applied to a determination of the origin of the mammals, and if this origin cannot be reasonably explained in any other way, then the only reasonable conclusion based on the evidences of Evolution is that the mammals have sprung from a common reptile-like ancestor; that these ancestors developed a four

chambered heart, threw off the egg-laying process of reproducing their kind, changed their scales to hair, gave birth to, suckled and cared for their young and became mothers. These new creatures began to develop and to increase their brains to guide them in their struggles for existence. They began to disburse and to adapt themselves to their surroundings and to seek out food for their sustenance.

The greatest factor in developing the vast numbers of different animal forms is that of selecting food. As a particular food was selected by one of these creatures to nourish and sustain its family, Nature changed the form of its body and developed its body organs so that the particular food thus selected might be more easily obtained. If this particular food gave out or if another kind of food was selected, Nature again shaped its body form and body organs so that it might secure and utilize the new diet in the most economical manner. The shape, bones, teeth, skin, claws and muscles of each species were thus developed and changed.

The ground mole chose to burrow in the ground and to live on grubs and worms. Nature developed its huge paddle shaped clawed forefeet for digging its way through the soil. Nature had given to it eyes but since it forsook the beauty of day and the pleasure of seeing, Nature has robbed it of its eyes which are now of its own choosing useless and rudimentary. The giraffe and its immediate ancestors developed a liking for the tender top branches of the trees in its surrounding and Nature aided it by developing for its use long legs and a long neck so that these sought after tender top branches might be more easily secured and with the least effort. The giraffe's long neck has exactly the same num-

ber of bones as has the neck of a man. The elephant began to develop long tusks and of such porportions that it could not crop the grass and tender shoots by reason of the interference of its tusks. Nature in order to overcome this difficulty developed for it a flexible proboscis made up of 40,000 muscles, tendons and tissues with which it could gather and feed itself. The elephant would now be extinct from starvation, had not Nature developed its efficient trunk.

In the history of all mammal life there is, perhaps, no more conclusive and satisfying illustration of the change in animal forms and of their adaptation to environment than is the evidence furnished by the horse. The horse's ancestry may be traced back through an unbroken line for a period of approximately 3,000,000 years at which time its ancestors were no larger than a fox with four complete toes on each forefoot and three on each hind foot. There is considerable evidence to support the belief that the ancestors of the ancestors had five toes on each foot as do most of the present day mammals. Through the fossil evidence which they have left to us, their life's history may be traced through succeeding stages of change and progress. During this long period of time the horse's ancestors passed through many changes in all parts of the body, but especially in the feet and teeth. These small primitive animals forsook the forests and parted company with their jungle cousins and selected the open plains as a place for their habitation. The modern horse in a wild state still selects the open plains and plateaus as a place for its habitation. Here on these sun baked plains and plateaus the horse and its primitive ancestors have passed through eleven successive stages or changes which have cul-

minated in the form of the modern horse. These primitive ancestors probably deserted the forests and jungles in order to escape their jungle enemies or, perhaps, the scanty stunted herbage of these plains produced a more satisfying food, but in any event, there was no necessity for so many toes. The middle finger or toe began to increase in length and the toe nail to increase in size. This process continued throughout vast periods of time and the other toes began to atrophy and to be cast off. The horse now walks on its middle toe and its toe nail has developed into a hoof. But Nature does not cast off the work she has done through long periods in a single day. She uses, perhaps, as much time in the destruction of an organ as she did in its creation. The evolutionary process of casting off the unused toes is still at work. The little hoof like appendages on the inner sides of the horse's legs near the knee joints are simply the rudimentary toe nails of a toe that has been cast off for a lack of use and Nature has not quite finished the work of removing the toe nails. A corresponding change has taken place in the teeth to meet the changes in the character of their food obtained upon the plains. The contemporary ancestors of most of the quadrupeds, perhaps all of them, have modified their teeth to meet the changing conditions and character of the food that gives nourishment to their bodies. The compulsion of hunger must be satisfied if life continues to exist. When a food which has been used, either through necessity or choice, for a long period of time is no longer obtainable, then the animal using this food must change its diet and adapt its body organs to the use of the new food or perish. Nature, in

aiding its creatures, has chosen the plan of adaptation rather than that of extinction.

The fossil remains of the earliest known mammals date back to a period approximating 10,000,000 years ago. A comparison of all the mammal forms leads to the conclusion that all the orders of this class have sprung from a common ancestor. After this class had arisen above the preceding and lower class of reptiles, they began to increase rapidly and to disburse from the original home of the parent ancestors. Some took one road and some another. These roads lead to the uttermost parts of the world. In traveling these roads, they were led into new conditions and new surroundings which called for a change in their habits of living. Some progressed and some did not. A multitude of coöperating conditions extending over millions of years developed new species. All of the various orders have been forced by circumstances to pass through many changes. These various changes are more numerous and more noticeable in the active and ascending orders. These orders are constantly reaching out and upward. In this ascent, they have been punished for their mistakes and rewarded for their progress. The brain has gradually increased in size until the species possessing the largest brain now has dominion over all the world and its creatures. Through its functions, the Plan of Creation and the relation of all things to each other are now being revealed to the animal that has reached the topmost branch in the tree of animal life as a reward for its efforts.

CHAPTER XXII.

The Evidence Furnished by Embryology.

THE preceding pages of this "Outline" have been directed to a study of the progressive history of all life from the first original life cell to the present time. The changes in this life history have been so gradual and they have covered such long periods of time that they can only be classified in periods of geologic time. They are blended together like the colors of a rainbow. The fact of these changes cannot be denied when they are subjected to an analysis based on scientific tests. Progressive adaptations have taken place but the basic laws of Nature have never changed. If Evolution was Nature's plan in the beginning, it is now and ever will be the same plan. Any attempt to deny the laws of Nature challenges the laws of reason and the laws of God.

No other branch of science has furnished more convincing proofs of the methods of evolutionary growth than has that of Embryology. Here we can see the processes and changes of life's physical development taking place. All life is simply repeating the life processes of the past. These processes not only repeat the actions of the primitive forms through which all life has passed but, in addition thereto, they repeat all the actions gained by adaptation and modification in the development of the particular species.

Just as it was in the beginning so it now is that all life starts in the same way—from a single cell. The body of

every living person, creature and thing in all the world has been developed from a single cell. The first and original life cell contained the potential powers of all future life whereas the cells from which life now begins contains the history of the past and the potential powers of development which are possessed by the species to which the cell belongs. These animal cells are all made up of the same substances. They are round and are almost microscopic in size. They all have a tough, skin-like, transparent outer covering which surrounds and holds within its walls a protoplasmic substance and floating within this substance is a globular speck which in most cases can only be detected with the aid of a miscroscope. This globular speck is the germ of the future body. It is the life spark which contains the potential powers of development. There is no apparent difference in the form, size and composition of the germ cells of all the mammals. In fact, the germ cells of a man, a mouse, a dog, elephant, cow, horse, monkey or any other mammal are apparently the same but they each contain far different ancestral history since their remote ancestors started on different roads in their ascent of life. When these germ cells begin their process of growth, the first noticeable change is a division by partition or segmentation. The original cell is divided into two, the two into four, the four into eight, etc., until the adult form is reached when by multiplication and division the number has reached into countless millions. As the original cell begins its work of multiplication by division, each cell is put to work in building up the complex structure of the species—some working on one part and some on another but all in coöperation with the whole plan. One set of cells have been work-

ing on the skin, another the hair, another the bones, another the muscles and so on until the entire structure with its correlated functions is completed and again ready to reproduce its kind. Since the first or parent germ cell of the body first divided, nothing new has come into the structure except food and work. The forms of Nature have been changed but not the substance. The grass of the fields has been changed into bone, muscle, blood, skin and brain by the life processes of work and growth. Each organ has been developed for some particular function necessary for the preservation of the whole.

The embryonic development of all mammals is accomplished by much the same physical processes but human Embryology has an interesting appeal above all others because it concerns the development of our own bodies. Just as we have seen the development of writing, transportation, communication, art, music and all other accomplishments in Cultural Evolution from a crude beginning to a state of near perfection, so likewise the development of the embryonic cell, a thousand times more complex, may be traced with as much certainty in its various changes. It is not given to man to see the mysterious life processes which cause these changes but he can see the results of each change after the work is done.

The human embryo is moulded into shape and form like a drop of rain forming from the vapors and then moulded into the many angled snow flake or ice crystal. It does not begin as a human form, but instead, it begins with the form of its remotest ancestor. It does not assume the human form until it has repeated the forms through which its ances-

tors have passed. It develops within a few weeks' time the form or forms that required millions of years for its ancestors to assume. These kaleidoscopic changes, these various forms represent the superstructure of the life form that is to follow. Before a wheel of a machine can be cast, the ore must first be mined, smelted and transported; so in moulding the human form the preliminary work must be done in order that the basic structure can be formed. Each successive step in the development of the human embryo shows where one ancestor stopped and the next ancestor, a little better equipped for life's struggle, began. Each of these ancestors have played their part in the plan of life, and as they are again reincarnated as a part of the higher form toward which all life has tended, they each leave the useful accomplishments of their lives as a heritage for the higher life of which they are now a part. No effort in Nature is wasted. Mistakes have been made but it is through the overcoming of mistakes that perfection is attained. The useless parts have been cast off and the useful ones retained.

By way of illustration, let us suppose that a beautiful building is standing on some commanding landscape. It is constructed of many parts and its construction represents the experiences of the preceding ages. The materials of which it is made have come from no one time or place but they have been gathered and compounded into the beautiful and useful structure that it now is. The foundation stones have come from the quarry where they were formed millions of years ago. In taking out these foundation stones, the earth, and the defective parts have been left behind and only the pure and perfect parts have been used. The lumber

in this building has come from the forest. The trees from which it has come have withstood the storms of centuries but the limbs, bark, sapwood and the defective parts have been left behind and only the best and most perfect parts have been used. The metal parts of the building have come from the mines. The ores have been smelted and fabricated and the dross and slag have been left behind and only the pure metal has been used. The glass has been melted from the white unstained sand and all impurities and imperfections discarded and so on through the catalogue of all the parts of which the building structure is made. So likewise when all the preceding ancestors of man have contributed the essence of their lifes' work in building the various organs which form the complex human structure, then and only then does the human embryo assume human form.

The embryos of all mammals are the same or similar until the life processes of reincarnating the useful attributes of the common ancestors are completed but when the point is reached where the mammals began to take different roads in the ascent of life which led to new environments which necessitated new adaptations and in turn developed new forms, then the embryo takes on the form of the species of its kind. The negative of the picture is now complete. The processes of the development of all life that have passed through the preceding ages have been repeated within a few weeks' time. From this point or period of development, the family history plays the important part. But even at this stage of development, there are many parts which were useful to our ancestors under the environments in which they lived that are now no longer useful to us in the environments

in which we live and therefore they must be changed to useful purposes or cast off in order to permit the more perfect functioning of the useful parts.

Many of the changes through which the human embryo has passed before taking on its human form represent characters well known to men of science while others represent characters not known to them but it is known that they represent forms of departed types that belong in the chain of animal life and that in the dim, dark past, they were the highest forms of creation. Just as it is impossible for all of us, or perhaps any of us, to trace the lineage of our ancestry back fifty or even twenty-five generations ago and to know the influences that developed or retarded the bodies and minds of our direct ancestors of that time, so it is impossible for us to know the life history of all the departed types that have passed away leaving the gains of their lives as a heritage to the succeeding types. But we do know that they existed, that they played their part in the scheme of life, and transmitted their useful experiences to their descendants just as our direct human ancestors fifty generations ago have transmitted to us the results of their labors which have been reincarnated in us, their descendants.

The mysterious forces of life can neither be explained nor understood. The facts of Embryology cannot be challenged or disputed without abandoning the foundations of reason. The early life history of all life is reproduced in a moving panorama in the embryonic development of all mammals—step by step, stage by stage until the true mammal form climbs one step higher than the preceding forms have climbed. The urge of hunger and the compulsion to

reproduce their kind are ever present. The class as a whole begins to climb higher in the scale of animal life. Some take one road and some another. Some of these fall by the wayside and their types no longer survive. All encounter difficulties but the procession moves on each shaping its body by adaptations to aid it in its struggles for existence. Some develop claws and teeth, some long legs and fleetness of foot, some horns, some spines and some brains as aids in securing food and as a means of self-protection against their enemies.

It was ordained from the beginning that brain power, the force of reason, should rule and have dominion over all the creatures of the earth. Several families of the 10,000 species of this class began to rely on mental action more than on muscle, tooth and claw action as a means of securing food and as a means of self-protection. Mental action called for an increase in the size of the brain and as a consequence, the families that increased the size of the brain emerged from the crowd and climbed a step higher than all the rest.

The last and highest order of mammals that have advanced to a higher step above all others is the order that has developed the largest brain. Included in this order are the lemurs, monkeys and man. The anthropoid apes such as the gibbon, orangutan, gorilla and chimpanzee have reached the step next to the top in the ascent of life but man has outdistanced all of these and has reached the topmost step in the scale of life. The brain of the lowest type of man is twice the size of that of the highest ape. By developing a brain greater in size than all the others and by developing the power of speech, man has attained the position where he has dominion over all the other creatures of the world. With

these superior mental faculties, the power of speech and his social habits of coöperation, man has now reached a stage where civilization and Cultural Evolution began; where he began to change the forms of Nature to aid him in his struggle for existence, and where his actions were directed by reason instead of animal instinct. It has been a long road that life has traveled since life first started in the original cell but the road has been progressive all the way. The same electrons, atoms and molecules that quickened life in the first original cell quickens life in every living cell today.

CHAPTER XXIII.

The Evidence Furnished by Anthropology.

IN the jungle forests of early mammalian life, there were many perils that required much cunning to escape. Many of the weaker of this class took to a life in the treetops as a means of safety. True to evolutionary law, this new environment began to change the form and functions of their body members. Their brains began to develop and to devise schemes that would outwit their enemies. The toes on their forefeet began to grow into fingers sensitive to touch which enabled them to grasp and hold on to the branches of the trees and to hold the fruit and nuts while it was eaten in safety while they were perched upon a limb. Their forefeet became both combination hands and feet. This new environment had obviated the necessity for a keen sense of smell and, as a consequence, their long fox-like noses began to shorten and their sharp and pointed ears began to grow flatter and more round. At some time and place, we know not where nor when, the ancestors of man and the ancestors of monkeys parted company. One took one road and one another but both roads led in the same direction. That they were both tree dwellers, we are sure. Presently, the great apes appear upon the scene. Their fossil remains are found in many parts of the world. Their brains, in proportion to the size of their bodies, is much larger than the brains of any other known mammal up to this time. Their jaw bones are

heavy and their canine tusks completely interlock. Their skulls are thick and unfurrowed by the brain. Their thigh bones are curved outwards and they cannot as yet walk erect. The immediate ancestors of these great apes—the orang-utan, the gibbon, gorilla and chimpanzee, have passed through many changes—many steps in their ascent in the tree of animal life in order to develop their present forms. These great apes of the present day have many human characteristics. They have largely the same body form, the same number of muscles, bones, nerves and a similar composition of blood. Harmonious blood transfusion may be made between ape and man or man and ape but not with any of the other mammal species.

Many interesting stories are recorded of the habits and customs of these great apes in their daily life; of their throwing stones and sticks; of their vanity in decorating their bodies; of their love and affection for each other; of their methods of playing; of their limited and slow acting powers of reason; of their hatred, rage, jealousy and many other emotional characteristics the same as possessed by man. They are near human but not human. Man has not descended from either one of these but on the other hand, he has traveled a similar road in his ascent. He has outdistanced them all in his ascent. His ancestors have lived as contemporaries with their ancestors. Man has developed a larger brain, a chin, a larynx, a language, an erect body position, a straighter big toe, a larger heel, more level teeth and the powers of reason. The anatomical differences between man and the larger apes are slight but the size and convolutions of the brain place man at the top of the tree

of life. All these accomplishments which they do not have give to him mastery in the kingdom of life.

The immediate ancestors of man were super apes or ape-like men. They traveled not the same road as did the orang-utan, gibbon, gorilla or chimpanzee, but instead, they traveled the human road in their ascent. Just where or when the original ancestors parted company is not known but we do know that our body forms have changed from ape like creatures to that of human forms. Both man and the great apes have cast off their useless tails in the long ago. Both man and the great apes during their embryonic development have tails as long as their bodies which are absorbed and cast off before birth. The evidence of the immediate human changes from a lower to a higher form is not as plentiful as is that of the apes and other mammals but it is sufficiently plentiful to establish the scientific facts that these changes have taken place. Scientists have been searching in all parts of the world for information and proof that will solve the "Riddle of the Ages." They have been attempting to lift the curtain of time, to widen the horizon a little further into the past. Finally their efforts are rewarded, a little here and a little there. From Taungs in South Africa, there comes the skull of a five-year-old child that is more human than any of its predecessors. Its skull has begun to bulge, to fill out above the eyes. Its jaws are massive. It is not human—it is a super ape. Geologists place its age at a time when India and Africa were yet joined into one mainland. Then from far off Java comes the incomplete skeleton of something that is half human, half animal. It is neither man nor ape. It represents a step between the two. Its skull is

thick, its teeth are too small for the jaw of an ape and yet too large for that of a man. The convolutions of the brain show development indicating the beginning of the power of speech. The thigh bones are straighter indicating its erect or nearly erect posture while walking. The scientists of the world study it, compare and measure it and then declare it to be an ape-like man.

In the long, long ago when continental Europe was vastly different from what it is at the present time, when England was still a part of the main continent and Africa was joined to Europe in at least two or more places, the immediate ancestors of man were struggling with the wild beasts of the forest and plains for mastery and dominion. One of these, a representative of her own race and a mother of a race or races, has left to us her skull as an evidence of her physical make-up. This is known as the Piltdown skull. Let us examine it. It is a vast improvement over the child's skull of Taungs in South Africa and the Java skull which, as we have seen, were vastly superior and higher up in the scale of life than were their predecessors. She has tusks that completely interlock like those of a gorilla. Her skull has broadened until it is nearly as broad as it is long. Her eyes are set somewhat obliquely and do not set straight to the front. Her jaws are heavy resembling the jaws of the chimpanzee. Her back teeth have begun to flatten like those of a human. She has no chin but she has a distinct forehead and a larger brain than that of the low-browed Java skull. Her skull is thick and her brain is under-developed but its convolutions are beginning to show development. This race had developed the largest brain and the most nimble fingers and therefore,

at that early date, stood at the head of the animal kingdom. This slow thinking race, whose members were still half animal, half human, had begun to use artificial weapons to aid them in their struggle—weapons of wood, bone and stone to supplement the force of their powerful jaws and teeth. Their fossil intelligence is passed on to us in the form of the crudest implements known, the eoliths, the stones of the dawn.

The idea that was put into action by chipping a piece of flint into a sharp edged weapon or tool, became contagious. It was passed on from family to neighbor, neighbor to tribe and from tribe to the most distant tribes. A useful thought had become a heritage for the ages. The original discovery was improved upon and the skill of brain and fingers developed new tools and weapons and these in turn led to new and useful discoveries. It has been stated that our civilization began when man first struck a spark of fire from a flint or shaped it into a sharp-edged tool. If this was the beginning of our civilization, then civilization began during a period when the physical form of the human was vastly different from what it now is.

It must be remembered that climatic conditions of Europe were far different from what they now are when the first flint tools and weapons were made. The saber-toothed tiger, mammoth, cave bear, cave lion and many other, now extinct animals roamed and occupied the forests of Europe at that time. The herd instinct of man was fully developed at this time as a matter of self-defense and protection of his species. In just what manner these early races with their crude weapons outwitted and overcame these dangerous and fierce beasts of the forests before the coming of the spear and the

bow and arrow, we do not know and, perhaps, we shall never know these hidden secrets of the past. But we do know that man stayed and the beasts departed.

We have already seen evidence of the advances made by the above mentioned types—from Africa, Java and in Western Europe and now scientists place much stress on and classify the next and fourth great species of semi-human beings, as those whose fragmentary remains are found in Central Europe and sometimes known as the Heidelberg men. The evidence of this race of beings is based partly on a jaw bone found deeply buried near Heidelberg, Germany, partly from large teeth found elsewhere in this region and partly from skeletons found in a cave of Yugo-Slavia and partly from flint, bone and stone implements found near these remains.

The evolutionary changes of the teeth to those more human in form furnishes the key to the proof of their advancement above the foregoing species. The interlocking tusks are gone and the teeth are almost human in form. They had developed a higher degree of workmanship in the manufacture of stone implements and doubtless they had become more efficient in using them. As we may know the stages of man's later development through Cultural Evolution by the tools, and other useful articles that he has made to aid him in his struggles, so we may know the stages of early man's advancement by the same comparisons. The tools of the Eocene type had changed to those of the Pleistocene and these to a still higher type much more skillfully chipped than the preceding types—called the Acheulean.

Like a hound dog following the scent of a trail and the hunter and tracker the tracks of some certain animal after a new fallen snow, certain men of science are following the dim paths of early human progress that date back to a period, perhaps, 200,000 or 500,000 years ago. These trails may be lost for a time on some wind swept ridge or in a mass of bramble where they are mingled with and obscured by many cross trails; but they are gathered up again at points where their identity is certain and positive and the trail is more pronounced than ever before. These men of science have been developing the negative of human forms and actions that obtained in that remote period which we call the "dawn of civilization." We must look through a dark veil, the shadows of time, to see the real picture but these negatives are being developed into pictures of life as it was in the dawn of our human existence.

The next great step in the ascent of the human line is found in the Mousterian or Neanderthal men. This race is called Mousterians in England and Neanderthal men in Germany but they were the same people who inhabited most of Europe, Western Asia and Northern Africa before and during the last or fourth great Ice Age. They were the dominant creatures of the earth during a period about ten times as long as the entire historical period of mankind. They had climbed higher in the scale of animal life than any of their predecessors had done. They were horrible looking creatures but they were the first to reach the stage of development wherein they are classified as human—just one step beyond the dividing line between animal and man. Let us examine the evidence that they have passed on to us so that

we may know something about their forms and the activities of their lives. They were short in stature and heavy built, the tallest being about five feet three or four inches tall. Their eyes were extremely large and round and their eyebrow ridges resembled those of the gorilla. They had a low receding forehead, a thick broad skull, broad noses and short thick neck. They had massive jaws, a protruding mouth but no chin. Their teeth are more nearly human and yet not human; in fact their teeth bear evidence that for a considerable period of their existence they were herbivorous in their habits although at a later date they were flesh eaters. Their hands were stubby, the fingers and thumbs short. For the most part their bodies were supposed to be covered with a thick coating of hair. Their big toes are widely separated from the other toes much in the same fashion as those of the great apes. Their thigh bones are still curved outwards indicating that they have not as yet reached a straight upright position. The convolutions of the brain have begun to show in dim foldings.

We are sure that Cultural Evolution is as yet, figuratively speaking, in an embryonic state. That it began with the immediate predecessors of the Mousterians, can not be doubted. But what did this race contribute as a heritage to the succeeding races of men? Let us examine the records they have left behind for this race is now extinct; but the monuments of their activities stand as guide posts along the road that the human family has traveled in its ascent from a lower to a higher state.

They had begun to develop a spoken language—to designate objects by names. In their time, perhaps, an idea or a

sentence was expressed with a single word. Anatomists tell us that their language must of necessity have been very simple. They developed and used new weapons of stone and improved on the types that they had inherited from their predecessors. They were the first, so far as is now known, to make use of fire as an aid in keeping warm. The ashes of their fires may still be found in many caves. They were the first to use the rendered fat of the animals they had killed for artificial light. Crude grease lamps have been found in the caves that they occupied. They were the first to begin the art of picture making by transforming some vivid memory picture of the chase to the cavern walls that afforded them shelter and protection. As the great Ice Age came upon them after they had lived for thousands of years in a warm climate, they were, doubtless, the first to make use of the skins of animals for clothing. They believed in a reincarnated life after death because they buried their choicest tools and weapons and a bountiful supply of food with their dead. They were the first "cave men" as a matter of self-preservation for when the great Ice Age came upon them, they had to migrate to a warmer climate, to seek the shelter of the caves or perish. But their race is run. They have vanished from the earth after being the dominant creatures thereon for a period of approximately 100,000 years. They may have died from starvation as a result of a famine. Their food supply may have moved on or given out. They may have died from pestilence. Their skeleton forms bear evidence that they suffered from many of the same ills that we suffer today from mastoid abscesses, toothache, arthritis and many other human ills. The Searchers tell us that we are

not their descendants but that we have descended from another race and that there is much evidence to support the belief that we have come from the Piltdown race. But where have they been during these 100,000 years? It has been suggested that on the coming of the great Ice Age, some of the other races moved on down into the tropical fertile country that is now the Sahara desert and there they lived and multiplied and after the ice of the North had disappeared, they returned again and exterminated the Mousterians in a series of savage wars. There is much evidence to support this theory that removes it from the realms of fancy.

When Cultural Evolution began among the ancestors of man, the electronic forces of his brain became more active. Brain cells began to multiply. New experiences gave origin to new ideas and new ideas called for new brain cells to carry these new ideas into execution and, as a consequence, these accumulating cells gathered in folds or convolutions and pushed the skull out and up. The skulls of some of the primitive tribes were long; some were broad and round but they all grew out and up. When man began to make things with his hands, the making of which was directed by his brains, the development of his skull which after all is only a bony encasement for the brains, began a rapid development. The useful discoveries of one tribe or race were passed on and copied by other tribes and racès just as is done to this very hour. Skulls of primitive man found in Southern Africa, in Australia, in Asia and in nearly all parts of Europe give unmistakable evidence of contemporary development. The form and character of the tools and weapons they used show also a contemporaneous development.

Thus far we are still in the "Old Stone Age" of man's existence. It started with the crudest chippings. The first purpose of the men of this age was to secure food and to protect themselves against their enemies. The manufacture of their tools and weapons show a gradual development in skill and workmanship. Someone developed the idea of shaping a flake of flint into a pointed spear head which could be fastened into the end of a shaft and with which a more telling blow could be struck and at a farther and safer distance. This beneficial idea was seized upon and copied by all the primitive tribes throughout the world. Then another, even more original and thoughtful, invented the bow and arrow. This simple invention which has been mentioned in an earlier chapter of this "Outline" has been one of the greatest if not the greatest factor in giving to man dominion and mastery over all the beasts of the world.

During this period of man's history, another group of this race began to satisfy their artistic obscessions by carving images upon bone, horn, tusk and stone. Another group began to make bracelets, necklaces and pendants from teeth and shells as ornaments for their bodies. Their barbaric crowns were studded with the teeth and horns of the victims of their chase. Like the atrophied toe nails of the horse, these barbaric displays of vanity still cling to us, their descendants. Cultural Evolution will in time cast them off as it has so recently cast off the song birds as ornaments to the headdress of our sisters.

During the vast period of time covered by the "Old Stone Age" and the "New Stone Age," when Primitive Man fought his way to mastery with weapons of flint, many races,

now extinct or amalgamated, crossed the stage of human action and passed from existence leaving only faint trails of their daily lives. It is impossible to tell just where the labors of one ended and the other began. Amalgamation, perhaps, played a greater part in their passing than that of any other factor. Some were round headed and some had long heads. Some were tall and others short; some black and others white. Neanderthal Men were round headed but supposedly black and gorilla-like. The Piltdown Men were round headed, tall and supposedly white. There were the Horse Eaters of Solutre, the Magdalenian Carvers, the Mammoth Hunters of Predmont and the Azilian Crab-Eaters and others.

During Primitive Man's life on earth, he has experienced four great climatic changes—the four great "Ice Ages." Great ice floes came from the North turning tropical climates into regions of ice. These periods would come, drive all life before them, recede and then reappear again. Each of these covered long periods of time. As the last and fourth great "Ice Age" disappeared, there came from Northern Africa, Western Asia and perhaps, from regions now covered by the Mediterranean Sea, a race of humans following and living on the vast herds of animal life that were returning to the grassy plains, their ancient pastures from which their ancestors had been driven when the ice floe came. These men are known to science as the Cro-Magnard or Reindeer Men. They represented the dominant and highest type of human beings then living. They were the first to whom science has given the name of "True Men." They were tall, and erect, fleet of foot, had bigger and better brains, better weapons and greater skill in using them, a better social organ-

ization and toward the end of their 20,000-year reign, they began to construct crude huts as a place for their habitations. They were a race of wandering, naked savages, but superior to any race then living or of any that had preceded them. They were hairy-flesh-eaters from whom the white race has probably ascended. They have left a record of their manner of living in many places. They had no knowledge of planting seed and of tilling the soil or domesticating wild animals to aid them in their struggles. These achievements came at a much later period during the "New Stone Age" but long before the use of copper.

The ashes of their camp fires and the refuse heaps where they had gathered and feasted are found in many places. They were mighty hunters and lived by the chase. The long nosed, flat faced Soltureans of the Rhone Valley have left as an evidence of their hunting prowess the skeletons of more than one hundred thousand wild horses in a single camp upon which they had feasted. They had developed a high degree of skill in chipping flint and more than forty thousand flint implements have been collected from this one camp.

They continued in their advance following the herds of horses, deer, bison and elk until they occupied most of European territory. Their true types have disappeared, of course, but how? When they had occupied the regions where the ice had been and from which it had receded, they began to divide into separate tribes, to construct crude shelters and to lay the foundations for social order. We are not unmindful of the fact that a vast period of time intervened between their invasion and the coming of the Neolithic Men. There were amalgamations and assimilations among

the tribes. A story of these changes may be found in the many excellent works on Ethnology and Primitive Man. Except for some minor variations the physical form of the human body was now complete—the framework finished. There is no doubt but what their blood is mingled in the bodies of the white races today. In like manner the early ethnological story of the other races may be told. It was now the work of Cultural Evolution through the power of mind and the nimbleness of fingers to develop man to a higher state.

It has been a long time since Piltdown man matched his wits, his superior force of brain and the nimbleness of his fingers, with the horns, teeth and claws of the saber-toothed tiger, mammoth, cave bear, cave lion and many other primitive beasts. One hundred years ago, the people then living knew little or nothing of the life of man prior to the time of written history. But when the experiences and observations of many Searchers were joined into one stream, the study of man became a science known as anthropology. Through the aid of this science, we have learned much of his form and actions before written history began. And if we shall judge the future by the past, the succeeding generations will unearth much more evidence concerning their activities that we do not now have. From this period of human existence the activities of man are blended with what has been written in the earlier pages of this "Outline."

MARINE BIOLOGICAL LABORATORY
WOODS HOLE
LIBRARY
MASS.

CHAPTER XXIV.

Casting Off the Useless Organs.

DURING the thousand million years or thereabouts that life has been struggling from the first life cell to the present forms, the earth has been subjected to many geographic and climatic changes. These changes raised mountain ranges, submerged continents and turned tropical lands into regions of ice. As a matter of self-preservation, the existing types had to make adaptations in their forms and habits to meet these changes or perish. Many fell by the wayside and perished while others struggled on by adapting their bodies and habits to meet these new conditions and lived. These adaptations not only brought about changes in the form and function of existing organs, but they created new organs as well to meet the changing vicissitudes of life. It required æons to make and change these organs and other æons to destroy and throw them off. A complete new diet and a complete reversal of inherited instincts had to be substituted for the former ways of living. Nature never throws off a completed structure if the structure can be put to some useful purpose but when an organ has become outgrown and useless, it is Nature's law that it shall be cast off.

A consideration of the structure of animal forms brings us to one of the most conclusive proofs that God's plan of creation was the evolutionary plan. Man and all other animals contain, in addition to their useful organs, many rudi-

mentary organs which have been outgrown and which have not as yet, been completely cast off and destroyed. These vestigial organs are not shadowed by the hand of time for they are real, living parts of our own bodies and may be seen with the naked eye without the aid of a microscope. They stand as weathered monuments of the past marking the way which our ancestors have traveled in their ascent. Their existence and former functions can not be denied without destroying the very foundations of reason. They are found alike in the bodies of both man and the other animals. The body of man shelters more than seventy of these vestigial structures and their existence can be explained in no other way except the evolutionary way.

Evolution measures the work which it has done and is now doing not in terms of days, months or years, but, on the other hand, its work of both creation and destruction is measured in terms of geologic time. It required millions of years for the ancestors of the horse to develop its multiple toes and when its ancestors selected a habitation on the hard grassy plains where the leaf mold of the forests was no longer found and where a single toe was better fitted for its new environment, it began to cast off its useless toes—first the shortest and then the next shortest. Sufficient time has not elapsed for the complete removal of all of the useless toes and therefore we see the vestiges of the last receding toe in the form of an aborted toe nail far up on the horses' legs. There are cases where some horses and mules have somewhat reverted to their ancestral type by developing a vestigial hoof near the remaining hoof which in reality is nothing more than a developed toe nail on its remaining toe. This

is an instance where we can see the processes of Evolution still at work in casting off a useless organ.

The whale furnishes one of the most striking examples of adaptation because it has passed through all the stages of animal development until it reached the highest class and then, either from choice or necessity or both, it has returned to the environments of its ancient ancestors. During its ascent, it developed all the organs common to the mammalian class—a four chambered heart, warm blood, limbs and lungs, ears, a nose and perhaps a coat of hair. It gave birth to and suckled its young and lived for millions of years in much the same manner as did its contemporary cousins. But there came an urge and it left the land for which its organs had been patterned and returned again to the sea. Millions of years had been required to build up these land organs and now other millions of years will be required to throw them off. Evolution is doing this work of destroying the useless organs without in any manner interfering with its daily tasks. It still gives birth to and suckles its young but we have already seen that its young obtains its milk in an automatic "squirt gun" fashion. It is gradually assuming the form of its fish ancestors but its warm blood is kept warm by an abundance of fat beneath which its blood is circulated. Its teeth have disappeared and, in their stead, a new substance like a flexible bone has been substituted suitable for gathering its food supply. They have developed huge fins or paddles and a horizontal tail fin as a means of propelling their huge bodies through the water and arising quickly to the surface. Buried beneath the smooth skin of their fore paddles may still be found the vestigial remains—

bones, joints and fingers of the fore feet that were used when their forefathers roamed in herds upon the land; and buried still deeper beneath the surface of the breast, the rudiments of the ancestral hind feet may still be found. The life history of the seals, walrus, sea cows, dolphins and all the other sea mammals may be traced in a similar manner. The vestigial organs in all of these tell the evolutionary story of their lives. In like manner the rudiments of outgrown organs may be found in practically all the bodies of all land animals which is the most persuasive and convincing proof that these changes have been brought about by adaptations to meet the conditions of changing environments.

The snail furnishes an example of the power of the Mollusca to cast off useless organs and to adapt their lives to changed environment. Its ancestors made their homes in the sea and there built houses around their bodies in the form of shells as a protection against their enemies. Either voluntarily or involuntarily, its ancient ancestors were cast upon or crawled out upon the seashore and were cut off by some obstruction and forced to adapt themselves to land conditions. While its ancestors remained in the sea, it was apparently an easy matter to construct its house, beautiful in design and coloring, from the minerals carried in solution in the waters surrounding it. But when its environment had changed and the materials from which its shell was made were removed, it had to set about making its shell in another way or live without one. Limestone is simply a collection of minute sea shells that have formed in the waters of the early sea. The snails seized upon this substance and began to construct their homes from the fossil remains of their

ancestral cousins. But suitable materials for shell making could not always be found, so some species of the snail family ceased to struggle for these materials and began to cast off their shells as useless armor. In some species of the snail, the shell has nearly disappeared while others still cling to ancestral habits of manufacturing sea shells for their bodies though a thousand miles removed from any part of the sea. They gather in great numbers in some shady places where the limey skeletons of the dwellers of the ancient sea are exposed and there they may be found working over the life's work of their ancestral relatives.

In the Echo River, in the dark recesses of the Mammoth Cave of Kentucky, there is found a species of fish. It is not known from whence they came but they have been hidden from the light of day for such a long period of time that Nature has robbed them of their eyes. Evolution has cast off and sealed up their eyes as a useless organ in the environment in which they have been placed, doubtless, for millions of years. When their heads are dissected, a nerve is found leading to the atrophied eye which is proof that, in the dim ages past, their ancestors enjoyed the light of day.

We have seen in an earlier chapter that the human embryo in its development repeats the forms of all life that preceded the human form. We shall now examine the human body for relics of an animal ancestral past that have played their part in the scheme of human life but have become outgrown. In the development of the human embryo, at an early stage, a tail is developed that is nearly as long as the body. As the embryo is developed into human form, this tail is drawn up and disappears from external view but at the

end of the vertebral column there are in every human being, the bones and muscles or the atrophied muscles of a rudimentary tail. The number of these bones vary in number from three to five. This coccyx and its attendant bands of fibrous tissue served the ancestors of man as a useful organ when they lived among the tree tops but after their tree dwelling environment had changed, it became useless and the external tail was cast off.

The teeth of man and of his immediate ancestors bear evidence of his change of diet. The huge interlocking tusks and cutting teeth of the early ape-like men bear evidence of their raw meat diet but when their food was cooked and their diet became mixed, their teeth took on a human form. Diet is the one and greatest factor in changing the form of the teeth. We have seen the flying crocodiles lose their teeth when they changed to an insect diet and develop a horn-like turtle mouth. Again we have seen the whale change its teeth for flexible bone to fit its change of diet. The tusks of the ape-like men are still found in a dwarfed form in the human mouth.

In the digestive systems of both man and the animals, many changes have taken place as the forms and food of ancestral life have changed. The most outstanding vestigial organ of the human digestive system is the Vermiform Appendix. In some of the herbivorous animals, especially the sheep, this organ is greatly developed and is of much use in digestion; while in man, it serves no useful purpose but serves as a dangerous receptacle or trap for foreign substances and which when its membranous parts become infected, will often produce death unless it is removed. It is

now a rudimentary organ but it has served a useful purpose along the pathway of human life.

It is a well-known fact that the special senses are much more highly developed in the wild animals than they are in human beings or in the domesticated animals that have been under the fostering care of man for many centuries. It was through the warning of these special senses that the approach of a dangerous enemy was detected. It was through these warnings that the species have survived their enemies. The early races of men were schooled in the laws of Nature so far as these laws affected their survival. Their sense of taste directed them in their choice of foods and enabled them to discern the wholesome roots and berries from the harmful ones. Their sense of hearing was developed to a degree equal to that of the wild animals. Their ears were pointed and movable. These were controlled by three sets of muscles, which, except in rare instances, are atrophied and useless.

Many animals of today, including cats, dogs, deer, moose and others, have the power of making their hair stand erect. Extreme fear or anger excite the muscles controlling the hair until it "stands on end." The ancestors of man possessed this power which, through lack of necessity, has been cast off as useless. The expressions that we often hear—"The cold chills ran up my back," or, "My hair stood on end" are expressions attempting to describe the sensation of an attempt of the atrophied muscles to raise the hair erect when the persons uttering these expressions have been subjected to some severe mental shock. These subcutaneous muscles have lost their power on all parts of the body except

the ones still functioning on the forehead and in some instances, the entire scalp.

It will be remembered that the fish purify their blood by extracting the oxygen from the water as it passes through their gills which are separated by slits or openings usually five or seven in number and which open into a chamber on each side of the neck or head. After the head takes form in every mammalian embryo, the next most prominent feature of the entire embryonic structure is that of the gill slits or openings on each side of the neck. So persistent is Nature in repeating the life forms of the past that there are many children born with these gill slits plainly visible being covered only with skin and in some cases, the openings are complete. In a short time after birth, these openings close but in many instances, some semblance of their markings are carried through adult life. Nature has made use of many outgrown organs by adapting them to some other useful purpose and one of the strangest facts which the science of Anatomy has brought to a common understanding is the fact that Nature has constructed the external and middle ear of the human species from the first cartilagenous gill opening and its surrounding parts.

The ancestral fish in the chain of life had developed lungs capable of extracting oxygen from the air before passing on to the Amphibian class. Up to this time, the sense of hearing did not exist. This sense was developed millions of years later than the sense of sight. But an organ capable of giving the brain a warning signal against the approach of danger and of receiving beneficial messages conveying human and animal thought was necessary for an advance-

ment to a higher plane in the kingdom of life. And thus Nature developed these delicate organs as the necessity arose.

Those who have hunted with hounds know the unbelievable degree of the delicate development of the sense of smell among the lower animals. The wolf and wolverine possess a sense of smell unsurpassed in the animal kingdom. They both possess a vengeance and a desire to destroy. They both can detect the scent of man or anything he has touched for days after he has passed by. All big game hunters must stalk the animals they desire to approach with the wind blowing in their faces lest the scent of their bodies will betray their presence while yet, in some instances, a mile distant from their intended prey. This delicate sense of smell is still retained by the gorillas and other great apes. It is only reasonable to suppose that early man and his ancestors possessed this same delicate sense of smell as a protection and as a means of escaping his enemies. But since Man has become the dominant creature of the world and is able to protect himself against the animals that fear him, he has lost much of his delicate sense of smell through non-use of the nerves of smell.

Comparative Anatomy has shown that, in many instances, there is a reversion to certain phases of ancestral types. Men are living today with thick coats of hair or manes running down their backs which are a recurrence of this characteristic of their hairy ancestors. The hair on the outer arm from the wrist to the elbow points toward the elbow, while the hair on the inner arm points toward the wrist. The same is true in all the great apes but not in the lower animals.

This is suggestive of similar habits among the ancestors of both. Again there are instances of record which show that a cross between the different races of men will revert back to the characteristics of the now lesser blood when many generations removed from the original cross.

The human body is the most complex mechanism which Nature has constructed. The physics and chemistry of non-living matter had laid the foundation for life and when the "life spark" was breathed into a certain compound of non-living elements, the mysterious processes of life began. From the beginning of life to its crowning development—Man, its physical and chemical actions have been in harmony with the physical and chemical actions of non-living matter. Biologists have made many attempts to define life, but these attempts have failed. All things in Nature are guided and controlled by unchanging laws. There is symmetry, design, purpose and harmony in every created thing, both living and non-living, from the electron to the most distant star. Again we repeat; "From harmony, to harmony, this universal frame began; from Harmony to harmony, the diapason closing full in man."

The complex mechanism of the human body is made up of a few of the eighty odd known elements, only fifteen making up the most of it. But these fifteen elements with the breath of life breathed into them rule and dominate all the creatures of the world. Through the processes of evolutionary growth, these elements have been woven into a perfect machine with the power of reaching out, in and up until our understanding has begun to grasp some of the mysteries of creation.

If we shall examine the organs of the body, we find that they are each designed to perform their particular function with the least amount of effort for Nature teaches economy in all things. All the organs of the body are in harmony with each other. The muscles, bones, nerves, the organs of special sense, and in fact all the organs of the body, are placed in the most advantageous positions where their functions may be performed without interfering with the function of any other organ. They are so related and in such harmony that an injury to one, injures all.

When Cultural Evolution began to develop, the power of brain was substituted for and began to replace the power of muscle. Mechanical hands and fingers began to use the physical forces of Nature. Mechanical eyes extended human vision and mechanical ears extended the range of human hearing and a mysterious brain endowed with the power of reason and understanding began to comprehend the simple processes of creation.

The vestigial organs of the human body were, at one time, necessary and real organs that helped to lay the foundation for the perfected body. Without their work in the ages past, our bodies would not now be complete. The story of the lesson they teach is best told by the eminent preacher, Dr. Henry Drummond in "The Ascent of Man," as follows: "Take away the theory that Man has evolved from a lower animal condition, and there is no explanation whatever of any one of these phenomena. With such facts before us, it is mocking human intelligence to assure us that Man has not some connection with the rest of animal creation, or that the processes of his development stand unrelated to the other

ways of Nature. That Providence in making a new being, should deliberately have inserted these eccentricities, without their having any real connection with the things they so well imitate, or any working relation to the rest of his body is, with our present knowledge, simple irreverence."

CHAPTER XXV.

The Life Spark and The Soul Spark.

AN attempt has been made in the preceding chapters of this book to trace a crude outline of the development of life from the first and simplest pulsating life cell to the present time. But, what is life? To this question, many hundreds of answers have been attempted but none of these are complete and satisfactory because they do not embrace the whole, for life is an active force so broad and comprehensive in its scope that it is beyond the powers of human definition. It cannot be defined, analyzed or explained. All of our special senses and powers of reason fail us in its comprehension. We have begun to know some of its attributes and purposes and how these purposes are accomplished but any attempted definition covers only a small segment of the whole. It is everywhere and everlasting and its creative purpose is to advance the kingdom of life by creative processes until created beings may know and understand the Creative Plan.

The greatest question that has ever challenged the minds of thinking men is—"how did these life processes come into being?" Men of all ages and men of all races have sought to discover the secret of the origin of life. We have seen that the human body is composed of a number of chemical elements. The first four of these, namely—oxygen, hydrogen, carbon and nitrogen make up the greater part of the

human body and they form the most important ingredients in the bodies of all plants and animals. One of the theories advanced in an attempt to account for the origin of life is that a meteor falling from the sky gathered a proper combination of chemical elements together with a sufficient amount of heat to generate the first life spark and set the first life cell in motion. The fallacy of this theory is self-evident. It implies a creative force before the first life spark came into being for from whence came the elements through which the life forces work and the meteor and the force that pulled it down? We know that there is the power of Thought—Mind—behind every achievement in Cultural Evolution. Man has recorded these thoughts for the benefit of others. These thoughts are invisible and intangible but yet they are of such great force that they change the habits, customs and the destiny of the human race.

The acts of setting the type, making the plates, and printing the book upon whose pages a masterpiece of literature is recorded are mechanical processes and yet these processes are directed by Thought. It is just as reasonable to assert that a ton of printer's type poured from a tall building, will in the process of the fall, assume the proper arrangement, letter for letter, ready to reproduce a literary classic without the aid of a guiding hand or creative thought. Every great painting and work of sculptured art must first be conceived in invisible and intangible form in the artist's brain before the pigments are spread upon the canvas and the marble chiseled into images of life. The chemical elements and the physical forces of Nature were created and set up as preliminary steps in the preparation for life. This statement implies a crea-

tive force before the chemical elements and physical forces came into being and in our present state of knowledge no more satisfactory answer for the origin of life can be given than that this creative force is the Infinite Life that we call God.

All the known facts of Science have been assembled and exhausted in an attempt to find a satisfactory physical explanation for the origin of life but none has as yet been found. The most reasonable and logical explanation for the origin of life is that the Infinite Life descended into matter and set the active life processes in motion in a single cell and that Evolution directing these life processes has developed all the life forms in harmony with the Creative Plan.

If the human body be dissected and analyzed, it will be found to contain chemical elements commercially worth, for the average body, approximately one dollar and seventy cents. There is found no difference in the composition of the bodies of the most ignorant and the most learned; the richest and the poorest, for the substance is the same. But the physical body is not the end toward which all evolutionary effort has tended. The physical body is only an agency designed to carry out the Creative Plan. Mind and Soul are the ends toward which all life has struggled. There are elements of genius in the brains of all normal humans that are capable of infinite development. There are germs of divinity in the brains of all normal persons which when quickened and developed, will make them God-like in spirit and action. The unlocking and quickening of these invisible life forces have, through Cultural Evolution, developed the civilization of the human family.

But from whence came the Soul Spark? Did it descend as a Divine gift of super-consciousness at any one time or place or did it travel the evolutionary road in its development the same as the Life Spark has done? It must be admitted that the Source from which these forces came was the same in the beginning, is now and ever will be the same but the Creative Plan was that these forces should be revealed to man according to the law of evolutionary development. When there is a constant sequence of events related as cause and effect, this causal relationship is defined as a law. There are natural laws and man-made laws. The natural or God-made laws embrace all actions arising from or out of all physical bodies and since both the power of Mind and Spirit have been incarnated in the body of man, and since they both came from the same source and are a part of the Creative Plan, it is reasonable to assert that it is only through experience that the elements of genius and the germs of divinity have been developed in the lives of mankind. There are moments of inspiration but development comes through experience and growth.

The Bible states—"There is a natural body, and there is a spiritual body." And again—"Howbeit that was not first which is spiritual, but that which is natural; and afterwards, that which is spiritual." There is no scientific formula by which the existence of the Spirit may be proved neither is there one by which a mother can prove she loves her child; but in a search after Truth, we are not limited to a scientific investigation. The Infinite Life or the God-spirit in us is not manifested through the special senses, but it is a conscious lifting force that is felt as joy and gladness.

Among the early Greeks, there were two schools of philosophic thought. The one taught: "You cannot be happy from within unless you are first happy from without"; while the other taught: "You cannot be happy from without unless you are first happy from within." The early Christian Martyrs who sang hymns of praise as the flames roasted their flesh proved that happiness is a conscious state that comes from within.

The Soul Spark began to manifest itself millions of years after the Life Spark began. It started as a faint spark of super-consciousness after life had climbed far up the tree of life. We do not know just when it started. It may have begun with the mother instinct but figuratively speaking we are sure that it had grown to the glow of a small torch when early man began searching for a stronger and higher power. All evidence points to the fact that as man began to think, the mysteries of soul power began to be revealed to him. The Infinite Life had again descended into matter and planted the elements of divinity in the being of man so that he could work out through evolutionary processes his relationship to the Creative Mind. Thus Evolution supplements the last above mentioned biblical quotation by showing why the spiritual comes after the natural because there was no necessity for the spiritual until there was human intelligence.

All the various religions of the world have had their origin in man's belief in a power or powers beyond his control and upon which or whom he feels dependent. The highest ideal of all religions is perfect harmony of will between the individual and the Power he worships. It is impossible

to know with definiteness the origin of religions but they have passed through an evolutionary process contemporaneous with and as a part of the development of civilization. And like all other phases of human activity, the greater and more advanced human culture becomes, the more variations in religion are shown.

What is perhaps the earliest evidence or manifestation of a primitive religion is found among the Mousterian cave dwellers who inhabited most of Europe some 50,000 years ago. Here skeletons have been found that show the manner of the burial of their dead. The bodies are surrounded with their choicest tools and weapons and an abundant supply of food, usually the joint of some extinct animal, is placed near by. The bodies are reclined with one hand resting under the head. These facts bear evidence that these early half human—half animal tribes had a belief in some life activities after death. It is not given to us to know just what their ideas of a hereafter were but their burials suggest a connection with the ideas of the burials of the American Indian who believed, that after death, they passed on to a "Happy Hunting Ground." It is, indeed, noticeable what a similarity in character is found among all primitive peoples of the world. A new idea was seized upon and passed from neighbor to neighbor, tribe to tribe, until it was carried and utilized in all parts of the world. The use of flint, the bow and arrow, the spearhead and many other useful ideas were carried and copied by the various races and tribes and it is only reasonable to suppose that the idea of a life after death found its way and became a common belief among all primitive people as they reached a certain degree of intelligence.

Likewise, there is a similarity in many of the legends and traditions found among nearly all of the primitive peoples. It is said that the legend of William Tell and also of the Great Flood or Deluge are found as traditions among many of the primitive tribes with only slight variations in the accounts. Many theories have been advanced as to the origin of the earliest religions. It is asserted by many whose opinions should be respected that the early religions began with the worshipping of the objects or forces of Nature such as the lightnings, thunder, rainbow, waterfalls, the wind sighing in the tree-tops, etc., whose mysteries overawed and filled the primitive minds with fear and that later their worship was extended to include hundreds of the objects of Nature.

Interesting as a study of the primitive religions may be, there is no space or need for an extended discussions of these in a work of this kind. The pertinent part is the fact of the process of evolutionary development in religion the same as is found in physical and mental growth. It is sufficient to say that the primitive religions passed through Naturalism, Animism, Fetishism, Shanmanism and others. These primitive religions both developed and degenerated. Each tribe or clan had a separate belief and religious custom, a separate god or many gods, a separate animal or many animals as objects of their worship. But about four thousand years ago, many of these religions began to crystallize into the universal religions of "Sun-worshipping" and "Snake-worshipping." From the tribe to the nation and from the nation to the world, is the evolutionary growth of the religions.

A universal religion is one which has no national limitations but embraces all the races of mankind. The universal religions are Buddhism, Islam and Christianity. A religion that embraces all of humanity can have no higher goal than the precepts it teaches. Like the human body, they all contain vestiges of the past. Human society will become spirtually perfect when all the religions of the world are blended in harmony and purpose and when all the members of society live in perfect harmony with this harmony.

The basic foundation of all religions may be found in the Ten Commandments and the Golden Rule. Likewise, all civil laws governing the conduct of human society are based on these laws. These rules embrace right and wrong, truth and love, all of morals and all of religion. Generally speaking, both standards of morals and forms of religion are birth-rights of the individual. As the precepts of both are instilled into the plastic minds of youth, so the concepts of morals and religion are formed. These concepts are subject to environmental and experimental change but these individual changes are the exception instead of the rule. The forms of religion may differ but the purpose and substances are the same. The purpose is to put the spirit of the individual in contact and harmony with the spirit of the Infinite Life from which the individual life has sprung.

In the Evolution of the human soul, it has passed through many dark ages of superstitions, prejudices, oppressions and persecutions, but the needle of its spiritual force has always pointed to the Infinite Life. This force has struggled for the equilibrium of harmony of the Infinite Life. Without the directing power of intellect, we cannot uncover the hid-

den secrets of Nature or penetrate into the realms of the Infinite Life.

The Evolution of mind, morals and religion have advanced hand in hand. Unfettered by the force of tyranny and despotism, they have always reached out and up into the realms of a higher life. What was unmoral a few centuries ago, we now treat as immoral and criminal. The nebulous clouds of misunderstanding are vanished and the light of Truth is becoming brighter day by day. Knowledge that was once conveyed by symbols and signs is now conveyed by books, newspapers, magazines, the radio and the moving picture. Science is carrying the torch, lighting the way, marking the pathway for civilization to travel. Vestiges of superstitious beliefs still linger in the minds of men the same as vestigial organs remain in his physical body but as the light of Truth and Knowledge come in, the superstitious beliefs are cast away. There is no conflict between Science and Religion for Science is Truth and true Religion is a knowledge of God and obedience to His created laws.

Our sense of vision conveys the vibrations of light and the shades of color to the sensitive brain cells where the images that have passed through the optic nerves are recorded. Through the vibrations of thought these images are reproduced and become permanent pictures on the walls of memory. These may be transformed into substance by the vibrations of brain cell action. Is it then not reasonable to suppose that Science may prove that the Divine Mind descends into matter through divine vibrations that are recorded in the sensitive brain cells that have the power and

quality to reproduce the force of the power they have received?

The Infinite Life is everywhere and in all things. It is from everlasting to everlasting. It is in harmony with all of creation. It was first revealed to Man through Faith. It is not given to all persons to know the facts which Science reveals but no one is denied communion with the Infinite Life because of this. A man's Faith is as much his own as the scientist's Reason is his own. Man's Faith works through his emotions and feelings and puts his spiritual self in communion and harmony with the Infinite Life. Faith laid the foundation for the facts which Science has proved. In the evolutionary development of the human soul it has been revealed to mankind that his own soul is a part of the great cosmic intelligence of the Infinite Life and that he is therefore, a part of Deity; that he is a creator and that creation has never been finished and that his God-given intelligence is a part of the Creative Plan. The work which man has accomplished through Cultural Evolution proves that he is a co-creator with God. This work of Co-creation shall continue until the cosmic intelligence of the Infinite Life shall be fully revealed to mankind. The Infinite Life has planted within the lives of mankind the divine urge to create. Any influence that quickens this creative urge lifts humanity to a higher plane—a little closer to the Infinite Life and any influence that destroys this creative urge, gives civilization a backward step. Without this creative purpose, society will decay and humanity will revert to barbarism or to the law of the jungle.

CHAPTER XXVI.

What The Future May Develop

IF we shall turn back the curtain of time and look down through the centuries to the dim horizon when man began to leave records of his mental achievements, we will find that civilization has been a constant succession of rises and falls of human effort. Nations have sprung up, have developed into greatness, have flourished in splendor and power and have then passed into decay and oblivion.

The "Rosetta Stone" brought to England in 1802 was the key that unlocked the hidden mysteries of the early Egyptians and added an account of their early activities to our storehouse of knowledge. During the present and past century, excavations in what once was Assyria, Babylonia, Mesopotamia, Egypt, Greece, Chaldea and many other places have revealed to us a succession of ancient kingdoms and empires in these places. Cities were built upon the ruins of other cities. These cities flourished, many of them for long periods of time and when they were destroyed, other cities would spring up on their ruins. For a long time many believed that the Troy of King Priam was a mythical city but explorations have proved it to have been real. It had been destroyed ages before the time of the blind poet, Homer, but excavations have revealed that it had been built on the ruins of several other cities. The ruins of these cities have left traces of the civilizations of their particular time.

These ancient nations began like a tiny ocean wave. They gathered momentum and size as they traveled but they finally were dashed upon the rocks and their force destroyed. The history of each succeeding nation represented the progress of its time but its end was the same. These nations were not formed by accident or chance, neither were their downfalls caused by accident or chance. Their history was the result of evolutionary laws. Their beginnings and their endings were the results of cause and effect. They had their being under despotic rule where Might made Right—where the Divine Right of Kings asserted—"You work and earn bread and I will eat it, you are My subjects, My slaves. Do as I command for I will forfeit your life if you do not obey me."

These were times when much of human thought was destructive instead of constructive; when men were ruled, not for their own good but instead, they were ruled to satisfy the personal ambition and the vanity of those who ruled over them; and when most of human thought was devoted to war and conquest. But as the people became more enlightened, the forms of government changed from one man rule to the rule of many and finally to a rule of the people themselves.

Democracy is defined as the rule of the people. Experience has shown that this form of government secures the best results for those people capable of efficient self-government. But Democracy did not come by chance. It came through ages of oppression, tyranny, suffering and bloodshed. The *Magna Charta* which the barons forced King John to sign at Runnymede in 1215 is regarded as the most outstanding milestone marking the progress of the people

in their fight for political and civil rights. But Democratic government, even after generations of experiments and trial, is far from perfect. There are many problems in Democracy that must be solved if this form of government shall long endure.

The evolutionary law of life is that every living creature and thing must work in order to survive. All plant life that furnishes food, clothing and shelter for man and beast is beset by enemies that must be destroyed if plant life shall continue. All animal life is preyed upon by parasites that live upon the labors of the animal whose bodies they inhabit thus sapping the life blood and vitality of their victim. These parasites must be destroyed if Nature is held in balance. So likewise, the Political Democracy under which we live is beset by political parasites whose dominating influence is sapping the very life blood from this country. They are living upon the fruits of other men's toil and unless this condition is corrected, unless these political parasites are forced to gainful employment, the wave upon which we have been riding will go the way of all waves—it will be dashed upon the rocks and its force broken and destroyed.

Evolution's time is measured in terms of eternity. Its laws apply with equal force to all creatures. A nation is a collection of individuals living under the same or similar circumstances and subject to the same political laws. Progress has developed through personal initiative and any condition or restriction that impedes personal initiative, destroys progress to an equal degree. No nation can permanently endure that fosters and enforces laws contrary to the laws of Nature.

Paternalism, beyond the immediate family and the herd instinct, is not a natural law. It is an outgrowth of society and much of it is the result of sentimental impulses. It will reach a saturation point beyond which no government can function without reducing its citizens to a condition of involuntary servitude. Dependence on paternalistic institutions destroys personal initiative and reverses the Laws of Evolution. It destroys self-respect, creates indolence and increases dependents instead of decreasing them. The recipients of too much paternalism and their ever-increasing offsprings become a burden on society and are, in effect, nothing more than human parasites living on the body politic.

Many thinking persons are now discussing the question —Has man built up a machine about him that will destroy his civilization? This is only idle talk for it is unreasonable to suggest that a helpful machine which man controls will be permitted to destroy the civilization that has produced the machine. The fault is not in the machine it is in the administration of the government under which the machine is operated. The machine may change the habits and activities of the men who did the work before the machine came into being but adaptation to environment is one of the fundamentals of the Law of Evolution. Man must adapt himself to changing conditions the same as all his ancestors have done.

There are billions of acres of idle land capable of producing sufficient food to feed many times the population of the entire world. The bodies of every man, woman and child in the entire world may be placed in an open pit dug within the boundaries of one square section of land and at a depth

of less than one-eighth of a mile. There are single states capable of supplying sufficient food for all of these if all the land should be intensely and intelligently cultivated and if a stalk of grain should be made to supplant every weed.

Nature offers and gives a bounty to the intellect of man as a reward for aiding her constructive plan. Human thought has changed the habits and customs of all the civilized races of mankind. These changes are not constant, they are recurring. The soil has been forsaken for the machine; but the machine has become so efficient that a movement back to the soil from whence the nourishment of all life comes, is inevitable. We must learn again the lessons our ancestors learned and apply them in a different way.

Man has scientific mastery over many of the latent forces of Nature but not all of them. The harnessing of these forces is only in the beginning. Who knows but what the heat of the summer's sun may yet be bottled up and stored away for winter's use or the frigid air of winter preserved so that climate may be tempered at the will of man? The firebug and the glow worm may lead to a perpetual chemical light that may transform the darkness of the night into an artificial day. The force of the wind and the ocean waves will, in time, be a servant to mankind and subject to his will. Long distance travel will, doubtless, be conducted through the stratosphere at a speed now undreamed of. Mental telegraphy may become a fully developed science requiring no mechanical aids in distant communication. Man may discover a process of extracting the moisture from the air and be able to produce artificial rain thus insuring a continuous succession of bountiful crops. He may determine whether

human beings inhabit some of the sister planets and if such there be, he may develop a communication with them.

Who knows what geographic or climatic changes will take place during the next million years? It must be remembered that four great "Ice Ages" have taken place, changing climate and driving all life before their irresistable force. The last of these formed our Great Lakes and changed the climate and geography of the Northern Hemisphere. A forced change of diet or the use of soft prepared foods which our civilization has devloped may lead to a toothless race of men as it has done with other species of animals because Evolution casts off the useless organs and its operations are not limited by time.

The above suggestions may, at first thought, seem to be nothing more than fanciful dreams. That is all they are. But if we shall judge the future by the past, they are all within the realms of possible fulfillment. Dreams are the first flashes from the great cosmic intelligence that set the currents of human thought in motion and cause men to dare the impossible. They have been back of all of the great inventions and discoveries. They were back of the telephone, the phonograph, the moving picture, the airship, the radio and all the others. One hundred years ago, none of these had even reached the dream stage, and yet, today they are proven realities helping mankind along his upward path. Already, the currents of human thought have begun to move in the direction of the accomplishment of greater impossibles and when human thought becomes congealed and crystallized, it then becomes an irresistible force to which the laws of Nature yields her secrets.

The Laws of Evolution may be aided and their processes quickened and advanced by the coöperative efforts of man. Many thousands of examples may be mentioned where this has been done. Nearly all of our pot and garden flowers with their fragrance and beauty have been developed by the coöperative efforts of man from their wild state where they were struggling with other species for existence. The same is true of all our fruits, vegetables, cereals and domestic animals. Even the gold fish in your bowl or pool is a product of three thousand years of experimental breeding starting with a species of carp in eastern China. Who can imagine what changes will take place in our flowers, fruits, nuts, vegetables, cereals, poultry and domestic animals after another thousand years of coöperative effort of man and Nature? Without human coöperation, many of these will become extinct species because they have been so long under the fostering care of human hands that they have lost their power of adaptation while the remainder will revert again to the wild state in which man first found them. A reversal of the Laws of Evolution always leads to degeneration and destruction of the species.

From the first pulsating "life spark" to the present time, there is an intervening period of something like a thousand million years. This period is so short that there is no known method of comparing it with eternity. The one is finite, the other infinite.

The greatest problem that faces civilization is the destiny of the human race. Evolution has brought the human race to its present conditions of existence and the processes of Evolution will determine its destiny. Its highest achieve-

ment at the present time is the creation of a creature endowed with the power of understanding the processes of his own creation. Its highest purpose is to make all of these creatures happy, healthy and helpful and to blend their lives with the harmony of the Infinite Life in order that they may each become co-creators with the Creator.

The first life cell from which all life has developed contained all the latent powers of all succeeding life. Each human life cell contains not only the history of the past but the eternity of the future. Man has only recently begun to learn something of the Laws of Heredity and the knowledge gained from this branch of Evolution, will, when crystallized, probably determine the destiny of the human race. Based on the increase of the span of human life during the past seventy-five years, some medical authorities whose opinions are worthy of our consideration, assert that the span of human life may be extended to a period of two hundred years or more.

Civilization is fast approaching a Chemical Age when synthetic foods and other articles will be the rule instead of the exception. The chemical processes of Nature that transforms the grasses and weeds of the fields into milk and muscle, fats, hides, horns, hair and wool will, doubtless, be understood and through the processes of chemistry, life sustaining human foods may be extracted from these same grasses and weeds. The future generations will be eating foods and wearing clothing made from substances concerning which we now know little or nothing. They will look upon our generations as generations of wasters. The human race will continue to change its habits and customs in the

future as it has done in the past. Human thought will bring about these changes. Each succeeding generation will leave a heritage for the future which the preceding generations did not have. The struggle for existence will continue. What Nature has done for us and our ancestors, chemistry and the machine will be doing for the future generations. No person knows what our civilization will be five hundred or a thousand years from now. The future generations then living will be discussing the crude methods we now use in our daily life. If our civilization shall be destroyed, it will be because it has violated Nature's laws.